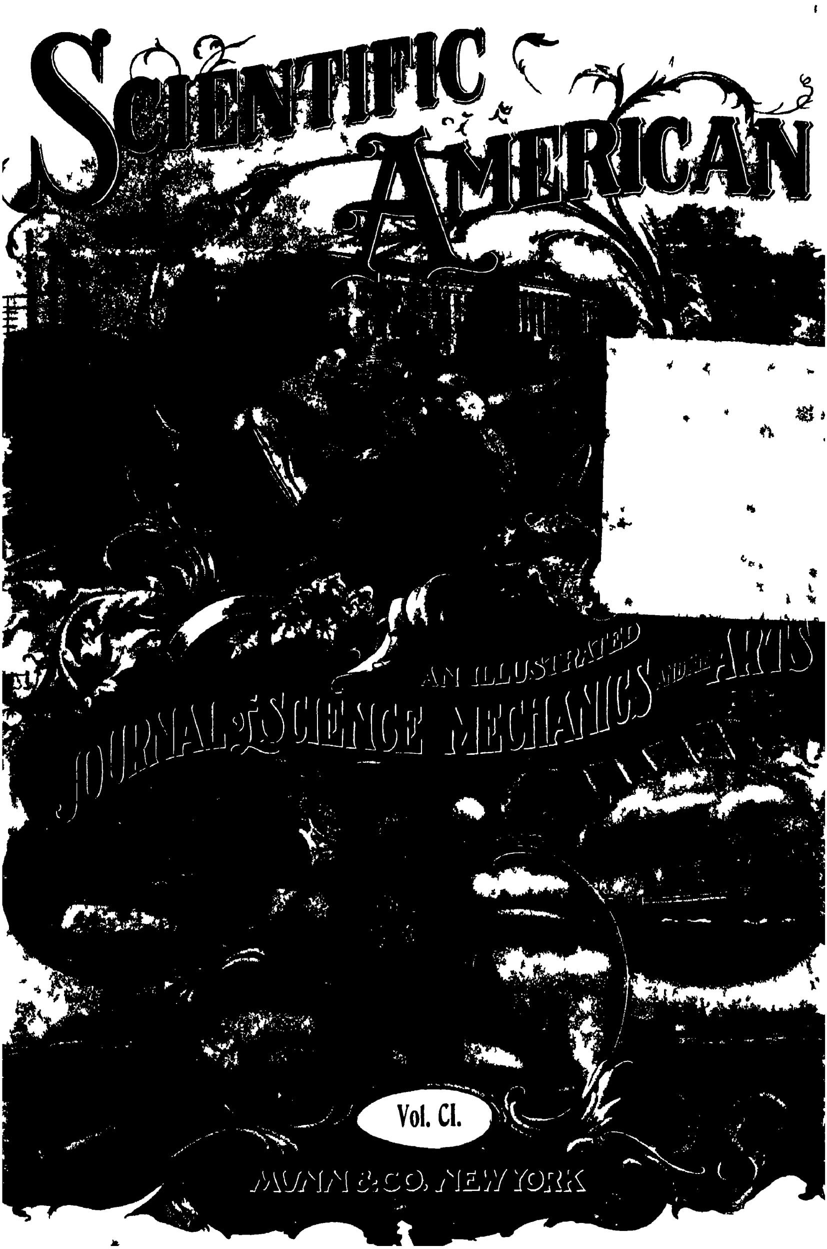

SCIENTIFIC AMERICAN

AN ILLUSTRATED JOURNAL OF SCIENCE MECHANICS AND THE ARTS

Vol. CI.

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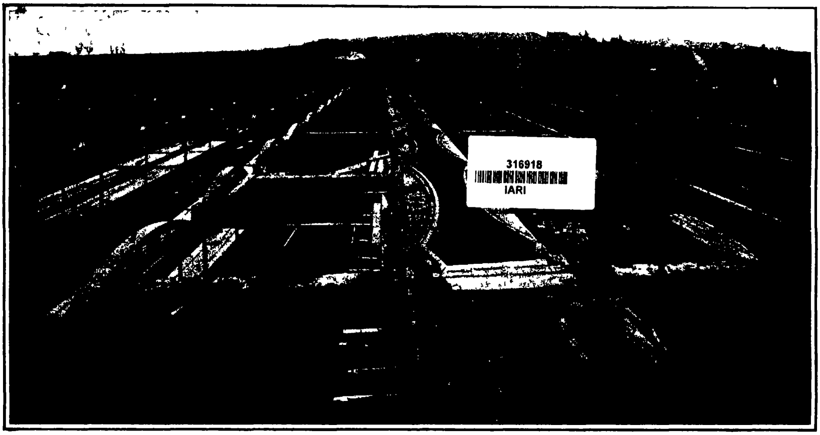

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View along one of the walls which divide the reservoir into four sections. The connected backs of the walls are visible

The arches that support the roof.

A HUGE FILTERED WATER RESERVOIR FOR LONDON.—[See page 11.]

SCIENTIFIC AMERICAN

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NEW YORK SATURDAY JULY 3rd 1909

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest If the photographs are sharp the articles short, and the facts authentic the contributions will receive special attention Accepted articles will be paid for at regular space rates

FACT AND FANCY IN AERONAUTICS

Somebody has said that the successful inventor is usually more or less of an idealist and invariably is possessed of a strong imagination Judging from the wild flights of fancy upon which an epoch making invention serves to launch the innumerable army of magazine writers we might add that in addition to being an imaginative idealist he would seem to be something of a hypnotist as well

As a matter of fact although the inventors of the steam engine the telegraph and the flying machine were necessarily possessed of a creative imagination they were essentially of a practical and conservative turn of mind Stephenson Morse Marconi and the Wright brothers may have found time in the midst of their busy hours to glance at the future and be momentarily thrilled at the thought of its splendid speculative possibilities but in the main they were too conscious of the inherent limitations of their inventions too strongly engrossed in the effort to work out patiently each nearest problem as it arose to indulge in wild prophecy of future accomplishment

The attitude of the Wright brothers during their wonderful demonstration of the possibility of mechanical flight may be referred to as proving the truth of the above observations Although they have created the art at least as far as its practical expression is concerned we doubt if anyone who has spoken or written on the subject of the development of flight has been more reluctant to predict the achievements of the future or more conservative in pointing out the inherent limitations of the art On the other hand it is rarely that the birth of a new invention has brought forth such a flood of preposterous and impossible literature as has appeared during the last few months on the military and commercial future of the dirigible and the aeroplane

Without in the least disparaging the fine achievements of Lebaudy Zeppelin the Wright brothers Curtiss Farman Bleriot and others whose intelligence pluck and perseverance have made aerial flight the sensation of the day we wish to draw attention to the fact that in their present state of development neither the dirigible nor the aeroplane has the slightest practical military value The best that can be said of them is that when certain inherent defects have been overcome they may in a limited degree be put to military use At the present writing this field would seem to lie exclusively in the direction of scouting and the carrying of dispatches

In proof of this we point to the fact that at present both the dirigible and the aeroplane and particularly the latter require both for their starting and landing the provision of a large fairly level field or campus free from the obstruction of trees telegraph poles and wires and buildings In the case of the aeroplane it is even necessary for safe starting and stopping that the surface be free from tall weeds or grass, for should the machine in coming to the ground dip sufficiently for one wing to sweep in among the long grass the contact is sufficient to swing it violently around across its course at the risk of wrecking the chassis or runners Furthermore the well known reluctance of the aeronaut to start into the air in anything stronger than a moderate breeze particularly if the wind be variable is very significant of the present crude condition of the art considered in respect of its commercial or military value. We do not hesitate to affirm that there are many years of patient mechanical development and practice in the air ahead of us before we shall see the production of an aeroplane which can arise or alight (as it must necessarily do to be of practical value) with that independence of time place and weather conditions which marks the flight and the coming and going of the birds of the air

Perhaps the most absurd of the military claims made for the airship and aeroplane is that of their ability to sail over hostile territory and destroy cities fortifications and military depots by the expedient of dropping high explosives In view of the great range of modern artillery and the fact that a special type is now being developed to repel airship attack the machine must operate at a height of at least a mile above the earth if it is to be safe from shrapnel and the special shells which will be furnished for its destruction At that height it would be a question of the merest chance if a bomb released from the machine struck the object aimed at There would be no means of determining if the fort magazine etc was in exact vertical alignment at the moment the missile was dropped Allowance would have to be made for the velocity of the wind which velocity could not be known to those who were moving in midair Moreover the direction of the flight of the projectile would be the resultant of the vertical velocity due to gravity and the horizontal velocity of the ship itself Consequently to make a hit the projectile would have to be released before the machine was vertically over the object and at a certain specified distance ahead of the vertical line How would the operator determine the exact moment at which to let go? It is evident that even approximately accurate aiming would be out of the question and the limited amount of ammunition which could be carried even by a large dirigible would render an attempted bombardment the most foolish kind of a farce The 11 inch high explosive shells with which the Japanese bombarded the Russian fleet in Port Arthur failed to inflict vital damage It is now well known that the Russian ships were sunk by the Russians themselves who opened the seacocks and flooded them In the many weeks of bombardment the Japanese hurled hundreds of tons of 11 inch shells on the Russian fortifications fleet and buildings without bringing Port Arthur to capitulation It was the sappers and miners that reduced the fortress The damage that would be inflicted on a beleagured city by a whole fleet of dirigibles could never by any possibility have a decisive effect upon the issues of the war

We repeat that the *present* indications are that the airship and aeroplane of the future even when they have been developed to their ultimate perfection will find their field of usefulness exclusively in the work of scouting and the carrying of dispatches

THE CAPE COD CANAL

The turning of the first sod in the work of cutting the Cape Cod canal on Tuesday June 22nd which took place on the farm on which Commodore Perry of Lake Erie fame was born was an event of more than local significance Great as the value of the canal will be in shortening the sailing distance between New York and Boston and avoiding the perils of navigation around the greatly dreaded Cape Cod the new waterway will ultimately take on a national and military value as forming an important link in that future system of related canals along the Atlantic seaboard which has come to be known as "the inside route" by which it will be possible for shipping to make the voyage from Boston to Norfolk Va in sheltered bays inland waters and reaches of canal without once passing outside the ultimate coast line

The canal will extend for eight miles from Barnstable Bay to Buzzards Bay and at each entrance will be approaches which will bring the total length of the canal up to 12 miles It will have a surface width of from 250 to 300 feet a bottom width of 160 feet a least depth at low water of 25 feet, and a mean high water depth of about 30 feet The canal will be built at sea level and with these generous dimensions it should prove adequate for many years to come for the class of coastwise freight and passenger steamers that will make use of it

The Cape Cod canal will form then the first link in a chain of interior waterways, which because of its commercial and military value is certain of ultimate construction A ship sailing from Boston for Norfolk after leaving the southerly entrance to Cape Cod canal would run through Buzzards Bay into Long Island Sound and thence by way of the East River and New York Bay to the Raritan River From the Raritan it would proceed by canal across New Jersey to the Delaware River and the present canal from the Delaware River to Chesapeake Bay after deepening would carry the ship to deep water in which she could reach Norfolk on a clear course. It [illegible] not contemplated [illegible] the [illegible] on the southerly [illegible] the [illegible] of the [illegible] ity as the Cape Cod canal. Ultimately, as trade developed, this section would be widened and deepened to accommodate a larger type of ship

The advantage of the inside route from the military point of view is that it would make it possible to transfer gunboats torpedo boats, and submarines from one fort or harbor to another, without interference by a blockading fleet of the enemy The advocates of the canal claim that the elimination of the dangers of the outside coast route especially at Capes Cod and Hatteras would greatly stimulate the coastwise trade, the increase of which coupled with the reduction in the time of passage would have a [illegible] effect in cheapening the cost of the transportation and reducing railroad rates. It is estimated by the engineers that the Cape Cod canal will be completed in from three to four years at a cost of $12 000,000 The borings along the route have revealed the existence of sand and gravel with some clay and the work of construction will be mainly one of straightforward dredging

THE COPYRIGHT ACT.

The new copyright act about which there has been so much agitation for the past two or three years, is now an accomplished fact the provisions of the act having gone into effect on July 1st, 1909 The new measure cannot be said to be amendatory in any way, for it prescribes an entirely new form of procedure

For a long period of time lawyers when advising their clients with reference to the requirements which should be followed to obtain copyright protection in the United States have emphasized the necessity of complying with the provisions of the copyright act before the subject matter is published The new act completely upsets this long established practice for it provides unqualifiedly for the publication of a book or other such work with the notice of copyright printed thereon as the first step toward procuring the protection desired After the publication of the work, with the notice of the copyright an application for copyright registration must be filed with two copies of the work In cases where the work is not to be reproduced in copies for sale the registration is secured by filing with the application a manuscript or typewritten copy if the subject matter be an oral address a dramatic composition or a similar work and should the subject matter be a drawing sculpture or a similar work a photograph thereof should be filed with the application

When a book of foreign origin is printed in a foreign language it is unnecessary that the book be printed in the United States but this is an exception to the general provision which requires that the printing of a book shall take place within the limits of the United States Books published abroad in the English language may be protected by an *ad interim* copyright but the application must be filed within thirty days of the publication abroad and as the term of the *ad interim* copyright is only thirty days it is necessary to reprint the book in the United States and publish it not later than during the sixty days following the foreign publication

The scope of a copyright registration of a musical composition has been extended to enable the proprietor to prevent others from copying the subject by mechanical means but should the proprietor permit the subject matter to be reproduced by such mechanical means he may be compelled to grant licenses permitting others to use the subject matter on similar means for reproduction, the licensee to pay a reasonable consideration for the grant of the license.

The term of the copyright registration is still twenty eight years but the renewal term has been extended from fourteen years to twenty-eight years

◆

At the First Census but six cities reported a population of approximately 8 000 inhabitants. Compared with this number in 1900 there were two hundred and eighty-six cities and towns in the same area having a population of 8,000 or more. In Rhode Island alone, the smallest of all the States, there were more cities of 8 000 inhabitants than there were in the entire United States in 1790 The aggregate population of all cities in the area enumerated in 1790 which in 1900 reported more than 50 000 inhabitants, was 135,997 in 1790, and 10 [illegible] in 1900 Although the total population of the United States increased rapidly from 1790 to 1900, the relative population [illegible] of New York, Philadelphia, Boston, and Baltimore increased [illegible] rapidly. In 1790 their combined population was but little more than 100,000 and formed but [illegible] of the population of the Republic; but in [illegible] approximately 6,000 000 or nearly [illegible] in 1790, had formed [illegible] per cent of the [illegible] the Republic. The population in 1900 of [illegible] ally enumerated as comprising these cities in 1790 was 830 000 or a sixfold increase of [illegible] within the original city limits

ENGINEERING.

The cost of foundations for new buildings in New York runs at times into very high figures. The contract for the foundation work of the new 25-story Municipal Building to be erected at the Brooklyn Bridge entrance has just been let to the Foundation Company for $1,443,147 The caissons must be carried down below the Subway station to rock, which lies in places 80 feet below street level

The work of constructing the Cape to Cairo Railway is to be started again in the near future The present end of the line is 370 miles north of Victoria Falls and it is expected to carry the line into the Congo copper district during the present season The new line will not be an all rail route A considerable part of the distance will be covered by steamers on the great interior lakes of Africa

Both Canada and Australia have followed the lead of New Zealand in the decision to contribute to the naval defense of the empire The federal government of Australia has voted to build one 'Dreadnought' for the British navy The Canadian government will build and man a navy of its own to act as an auxiliary force to the fleet of Great Britain The plans call for the construction of eight first-class cruisers of the "Cornwall" type of 10 000 tons displacement ten torpedo-boat destroyers and ten torpedo boats The fleet will be built in Great Britain and the time and cost of construction are to cover the next five years

It is well known that the amount of snowfall in the Rocky Mountains determines the flow of water in the leading rivers that head in this range Consequently the snowfall has an important bearing in determining the volume of the floods which frequently devastate the middle Western States Many of the most important irrigation ditches moreover depend for their supply upon the annual snowfall To place it in a position to make an accurate forecast of the amount of water that will be released by the melting snow the United States Weather Bureau has established a series of snow-gaging stations in the Rocky Mountains

Two self contained motor street cars operating independently of underground or overhead conductors are to receive an important test on some of the branch lines of the Third Avenue Company in New York city One of these will be of the storage battery type and the other will be driven by a combined gasoline electric engine The gasoline engine will drive an electric generator whose current will be fed to the motors at the axles If the experiment is a success several lines whose business would not stand the large initial outlay for trolley construction will be equipped with whichever car of the two types proves more serviceable

It is stated that the Union Pacific Railway is planning to plant its right of way from the Missouri River to the Pacific with alfalfa At each edge of the right of way also will be planted a row of pine trees alternating with elms there being a tree at intervals of every two rods As the alfalfa becomes green early in the spring and remains so until late in the fall the ornamental effect should be decidedly pleasing Furthermore it is claimed that the grass and trees will furnish in certain localities a decided protection against snow drifts and washouts It is stated that the Chicago Milwaukee & St Paul Railroad proposes to do similar planting and grassing between Ottumwa and Kansas City

In one of a series of articles on English railways in the Railroad Age Gazette the writer W W Turlay states that the most important things we can learn from freight service in England are prompt dispatching and delivery Small lots of freight are collected by the railroad company's own wagons taken to the station forwarded and delivered during the forenoon of the following day to the consignees by the railway company's wagons A wholesale merchant in London can have a case of dry goods taken from his warehouse in the afternoon and count on its being delivered to his retail customer in Manchester 183½ miles distant the following morning at rates of from 72 cents for 112 pounds to $1.80 for 336 pounds and for amounts above 336 pounds at the rate of 48 cents per 100 pounds

A notable step in the preliminary work of selecting the site for a bridge across the Hudson River to be built jointly by the States of New York and New Jersey, was taken when the Governors of the two States recently inspected the two sites which had been selected as the most available, one at 179th Street and the other at 59th Street. A bridge at 59th Street would cost $30,000,000, and one at 179th Street, $10 000 000. The 59th Street site was favored by the Governor of New Jersey and the 179th Street location by the Governor of New York. A bridge at 59th Street would have the great advantage of providing a direct route from Jersey through 59th Street and over the new Queensboro Bridge to Long Island. Furthermore, it would tap one of the most important business centers on Manhattan Island.

AERONAUTICS.

Saturday, June 26th, was the hottest day of the year so far and the fact that about 2 000 people made the ¾ hour journey via subway and trolley car to Morris Park, Westchester and paid $1 each for admission, augurs well for the future exhibitions of flight which the Aeronautic Society proposes to hold at frequent intervals throughout the summer Last Saturday for the first time New Yorkers had an opportunity to witness a flight by a heavier than air flying machine and great credit is due the energetic officers and members of the Aeronautic Society for having provided this exhibition at a time when the attention of the public is drawn to the subject of flying by Orville Wright's second attempt to fulfill the government requirements of a one hour flight with passenger and a 10 mile cross country speed test at Fort Myer on the outskirts of Washington D C With the exception of this gentleman Glenn H Curtiss is the only other American aviator who has publicly flown in our country and Saturday was the first time he had ever made an exhibition flight before a large crowd of spectators On July 4th last he became the first winner of the SCIENTIFIC AMERICAN Trophy by making a mile flight across the fields in the aeroplane June Bug at his home at Hammondsport N Y Mr Curtiss was at that time a member of Dr Alex Graham Bell's Aerial Experiment Association and the June Bug was the third successful aeroplane which the association had built His new biplane which he has constructed for the Aeronautic Society is the lightest and fastest aeroplane of this type ever produced and the flights executed with it last Saturday showed it to be an excellent flyer In a speed test it traveled 46 7 miles an hour Its small size (29 feet spread) light weight (400 pounds complete) and slight head resistance making it considerably faster than the Wright machine although it has only the same power (25 horse power)

The visitor at Morris Park last Saturday found much that was interesting on exhibition on the lawn in front of the grand stand There were several aeroplanes not quite completed as well as models and a full size helicopter intended to be worked by foot power by two men The blades were rotated in this manner but the machine showed no tendency to rise There was sufficient breeze for some school boys to fly with kites and a score of them had a contest At about 4 P M Mr Curtiss made his first straight line flight Starting near one end of the track he flew nearly to the other end and alighted in front of the grand stand He then turned the machine around and flew back again Each flight was about a third of a mile in length Next Mr William H Martin a farmer and civil engineer of Canton O was towed in his glider by a Kissel automobile This glider is a monoplane with planes beneath it set at a dihedral angle It is provided with rudders and mounted upon a boat shaped frame on three wheels The auto towed it too fast and the glider got swaying badly Then the rope broke and the machine swerved to one side and smashed through the picket fence Mr Martin who is quite a heavy man was thrown over the fence upon the lawn Fortunately he received no serious injuries The society's wind wagon which has a 24 horse-power 4 cylinder air cooled motor and an 8 foot propeller made several sprints around the track at a 30 mile-an hour clip and managed to cast a tire off of one of the steering wheels It next engaged in a tug-of war with an ancient 2 cylinder Autocar runabout If it could get a start and jerk the runabout it could pull the latter backward but otherwise the latter was the victor Two hot air balloons were inflated and sent up with a man and a woman respectively Both aeronauts made successful parachute jumps and landed on the grounds Very late in the afternoon Frederick Schneider was shot off by the catapult in his Wright type aeroplane fitted with the Society's motor but even though the propellers were running nicely the machine only traveled 25 or 30 feet beyond the end of the rail the thrust developed by the propellers being insufficient to make it fly

It was nearly 8 P M before the breeze died down sufficiently to enable Mr Curtiss to make a flight with turns Most of the spectators remained however and they found it well worth while Starting again from the end of the track farthest away from the grand stand he flew down past the spectators at a height of 25 feet gracefully circling round the small bend and traveling rapidly up the other side of the course Then he turned again and alighted at the wide end of the egg-shaped track The spectators cheered and applauded throughout the entire flight which lasted about 2 minutes While by no means so noisy and dusty as the first track automobile races used to be this first circular flight above a race track in America was truly spectacular, and without doubt, when it is repeated and prolonged into repeated circlings many more thousands of people will flock to see it It is probable that on July 5th Mr Curtiss will attempt to set up a record for the SCIENTIFIC AMERICAN Trophy

SCIENCE

Lieut. Shackleton has returned to England He will lecture before the Royal Geographical Society on his Antarctic discoveries

Prof. George E Hale of the Mount Wilson Observatory has been honored in France by his fellow scientists His researches on the sun and on stellar evolution are regarded as authoritative

The largest order for radium in the history of radio activity was placed jointly by Sir Ernest Cassel and Lord Iveagh The quantity ordered is 7½ grammes equivalent to about ¼ avoirdupois ounce and the price is $150 000 This quantity of radium is to be donated to the Radium Institute to which attention has already been called in these columns

A Chinese takin has been mounted in the American Museum of Natural History The animal was captured in the mountainous regions of China and was presented to the museum by Mason Mitchell former American consul to China The takin has the characteristics of an antelope and a goat

It is said that a new supply of radium has been discovered in Portugal by Thomas H V Bower a member of the American Institute of Mechanical Engineers A certain stream the name of which is not disclosed was reputed to have therapeutic properties Mr Bower followed the stream to its source and discovered that it ran over a bed of uranium phosphate

Observations of the height of clouds made by directing a searchlight vertically upward and determining the angular elevation of the illuminated patch of sky from a fixed base station were continued at the astronomical observatory at Vienna during the summer of 1908 The results show that media capable of reflecting light were frequently found to exist at heights greater than 10 kilometers The column of light could be traced up to an altitude of 17 1 kilometers on May 31st and to 16 kilometers on July 27th The greatest cloud height was observed at 8 kilometers The height of the dust or smoke layer over the city was fixed on two occasions at 300 meters and 120 meters respectively Confirmatory observations were made occasionally from a second station distant 8 3 kilometers from the source of light

The substances commonly used for impregnating roofing paper and roofing cloth are not permanent in the air The desideratum is a substance of slight volatility and high boiling point which would be durable when exposed to the air and would resist high temperatures India rubber fulfills these requirements but it is too expensive for use A recent German patent describes the preparation of a cheap substitute for India rubber for this purpose The pitch like residues of petroleum coal tar certain animal substances (wool grease and other fatty matters) and some mineral substances (ozokerite and mineral wax) are exposed at a high temperature to a blast of air and to the oxidizing action of manganese dioxide and sulphuric acid and are subsequently treated with formaldehyde

A series of experiments has been made by T Koerner in Germany in order to find out what proportion of alcohol can be obtained from wood using the well known process of converting the wood into sugar by hydrolysis and then using the sugar to form alcohol by fermentation He made tests with sawdust wood pulp and like materials The matter was treated with dilute sulphuric acid and heated in a digester in which the pressure could reach 10 atmospheres It is to be noted that all the sugars are not fermentable so that the percentage of alcohol must be obtained directly after the fermentation and is not to be estimated from the amount of sugar The addition of sulphurous gas which is sometimes recommended is found to be a drawback for the production of alcohol He finds that the yield of alcohol is low at best For wood paste it is not more than 12 6 per cent and for dry wood 6 per cent From the present tests he concludes that it is not commercially practicable to obtain alcohol from wood in the above way

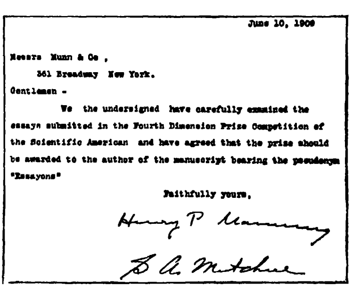
The determination of the characters of fibers composing a fabric by means of combined microscopic and chemical examination is often made impossible by interference with the characteristic reactions by the dyestuffs and metallic salts with which the fabric is loaded On the other hand the usual methods of removing dyes from specimens are apt to injure or destroy the fabric In a method proposed by Copetti the dye is discharged by means of hydrofluoric acid The sample of fabric is steeped five or ten minutes in commercial hydrofluoric acid contained in a leaden vessel It is then washed in water treated successively with soap 5 per cent hydrochloric acid hypochlorite of lime again with hydrochloric acid and is finally washed and dried The dye may also be completely removed by treatment with permanganates and sulphurous acid after the hydrofluoric acid bath This process leaves the fibers intact so that they can be recognized by microscopic examination and other tests

THE FOURTH DIMENSION SIMPLY EXPLAINED

The Essay that Won the $500 Prize Offered by a Friend of the Scientific American.

BY ESSAYONS (LIEUT-COL GRAHAM DENBY FITCH CORPS OF ENGINEERS U S A)

It is impossible to form a mental picture of the fourth dimension Nevertheless it is not an absurdity but a useful mathematical concept with a well developed geometry involving no contradictions To gain a partial and symbolic idea of its meaning resort must be had to analogy with dimensions of a lower order



June 10, 1909

Messrs Munn & Co ,

361 Broadway New York.

Gentlemen -

We the undersigned have carefully examined the essays submitted in the Fourth Dimension Prize Competition of the Scientific American and have agreed that the prize should be awarded to the author of the manuscript bearing the pseudonym "Essayons"

Faithfully yours,

Henry P Manning

S. A. Mitchell

An aggregate is said to be one two or three-dimensional according as one two or three numbers are necessary to determine any one of its elements Considering space as an aggregate of points a line is a one dimensional space because to determine the position of any point on it one number giving its distance from some fixed point suffices Similarly a plane is a two-dimensional space and the point aggregate of ordinary space is three dimensional Thus the exact position of any point of the earth is known when its latitude longitude and elevation above sea level are given Now if we have four variable related quantities each capable of assuming independently of the others every possible numerical value we obtain a four-dimensional aggregate Such an aggregate if of points constitutes four-dimensional space

If we connect all points of our space (a 3-space) with an assumed point outside of it then the aggregate of all the points of the connecting lines constitutes a 4 space (hyperspace) Again just as a point moving generates a line just as a line moving outside itself generates a surface and a surface moving outside itself generates a solid so a solid moving outside of our space generates a hypersolid or portion of hyperspace Or hyperspace itself may be conceived as generated by our entire space moving parallel to itself in a direction not contained in itself just as our space may be generated by the similar motion of an unlimited plane which may itself be generated by an unlimited right line Any space is that which forms the boundary between two portions of a higher space and just as every unlimited plane divides our space into two equal infinite parts so every 3 space divides hyperspace into two equal infinite regions between which that space forms a boundary of an infinitely small thickness in the fourth dimension

Two plane figures (say triangles) if in the same plane may partially coalesce but cannot intersect unless in different planes similarly two volumes (say cubes) if in the same 3 space may partially coalesce but cannot intersect unless in different 3 spaces In hyperspace we have the following possible intersections A hypersolid and a 3 space intersect in a solid two 3-spaces in a plane three 3 spaces in a right line four spaces in a point a 3 space and a plane in a right line a 3 space and a right line in a point and two planes in a point If the intersections are at an infinite distance the intersecting elements are said to be parallel and if two 3 spaces are parallel all figures or volumes in one 3 space are at equal distances from the other 3 space In the case of planes there are two kinds of parallelism and parallel planes are either completely or incompletely parallel according as they are in the same or different 3 spaces or as their intersection at infinity is a right line or a point

To a given right line at a given point one can erect in a plane but one perpendicular while in a 3-space one can erect an infinite number of perpendiculars forming together a perpendicular plane and in hyperspace an infinite number of perpendicular planes forming together a 3 space perpendicular to the given right line A 3 space can also be perpendicular to a plane or to another 3 space Planes may be perpendicular in two ways incompletely or completely perpendicular according as they are in the same 3-space or not in the latter case every right line of either plane is perpendicular to every right line of the other

The position of a point in a plane may be determined by its distance from each of 2 perpendicular right lines in our space by its distance from each of 3 mutually perpendicular planes and in hyperspace by its distance from each of 4 mutually perpendicular 3-spaces In hyperspace these distances are accordingly measured along 4 mutually perpendicular right lines which taken by twos determine 6 mutually perpendicular planes and taken by threes, determine the above mentioned 4 mutually perpendicular 3 spaces Just as in our space it requires at least 3 points to determine a plane so in hyperspace it requires at least 4 points to determine a 3 space A 3-space may also be determined by 2 non intersecting right lines or by a plane and one point not in it.

Just as portions of our space are bounded by surfaces plane or curved so portions of hyperspace are bounded by hypersurfaces (three-dimensional) i e flat or curved 3-spaces. Hyperspace contains not only an infinite number of flat 3-spaces like ours but also an infinite number of curved 3-spaces or hypersurfaces of different types A hypersphere, for instance, is a closed hypersurface all the points of which are equally distant from its center Five points not in the same 3 space determine it just as 4 points not in the same plane determine a sphere, and 3 points not in the same straight line a circle All of its plane intersections are circles all of its space intersections are spheres A hypersphere of radius R passing through our space would appear as a sphere with a radius gradually increasing from zero to R and then gradually decreasing from R to zero

While in our space there are but 5 regular polyhedrons (solids bounded by equal regular polygons) namely the tetrahedron cube, octahedron dodecahedron and icosahedron in hyperspace there are 6 regular hyper-solids (cells) bounded by equal regular polyhedrons. These are C^{5} (bounded by 5 tetrahedrons) C^{8} (by 8 cubes) C^{16} (by 16 tetrahedrons), C^{24} (by 24 octahedrons) C^{120} (by 120 dodecahedrons) and C^{600} (by 600 tetrahedrons) All of them have been exhaustively studied by mathematicians and models of their projections on our space have been constructed Of these C^{8} (or the hyper-cube) is the simplest because though with more bounding solids than C^{5} it is right-angled throughout, and therefore the standard form for measuring hyperspace It is generated by a cube moving in the direction perpendicular to our space for a distance equal to one of its sides. In Fig 1 where all dotted lines are supposed to be in hyperspace the initial cube is symbolically represented by $A\,B\,C\,D\,E\,F\,G\,H$ and the final cube by $A'\,B'\,C'\,D'\,E'\,F'\,G'\,H'$ the direction AA' being supposed perpendicular to our space Projecting the edges of a hypercube on our space we get a network model of which Fig 2 is a plane projection The eight bounding cubes are represented in the model by the following projections (1 2 3 4 5 6 7 8) (5 6 7 8 9 10 11 12) (9 10 11 12 13 14 15 16) (13 14 15 16, 1 2, 3 4) (1 5 9 13 2 6 10 14) (2 6 10 14 3 7 11 15), (3 7 11 15 4 8 12 16) (4 8 12 16 5 9 13 1) The form of the hypercube is conditioned by the mutual relations of these cubes that form its boundaries merely as it contains an infinite number of cubes just as a cube contains an infinite number of squares. In generating a hypercube by the motion of a cube, the latter's corners generate edges its edges generate faces (squares) and its faces generate cubes. The resulting number of elements of the hypercube is therefore as follows

	In Initial Cube.	Generated	In Final Cube.	In Hyper Cube
Corners	8		8	16
Edges	12	8	12	32
Faces (squares)	6	12	6	24
Cubes	1	6	1	8

Each corner is common to 4 mutually perpendicular edges to 6 faces and to 4 cubes) each edge is common to 3 faces and 3 cubes; and each face is common to 2 cubes. Every cube therefore has one face in common with 6 of the 7 others. We might conceive of the hypercube as composed of cubes starting from squares parallel to the faces of the cube and of these cubes all that exist in our space are the parallel squares from which they start.

In a plane the only kind of rotation possible is that about a point, in 3-space rotation any plane about

(Concluded on [illegible])

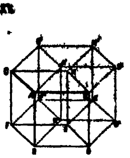


Fig 1.

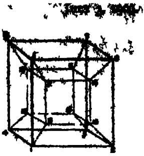


Fig 2.

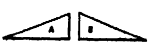


Fig 3.

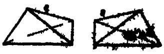


Fig 4.

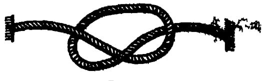


Fig 5

Graham Denby Fitch

Lieut Col Graham Denby Fitch the winner of the Fourth Dimension Competition is a son of Henry Satterlee Fitch (captain of volunteers during the civil war, served on Gen. Sherman's staff) a grandson of Dr Graham Newell Fitch (U S Senator from Indiana colonel 46th Indiana volunteers during the civil war) and a nephew of Col Charles Denby (U S Minister Plenipotentiary to China for over twelve years) He was born in 1860 in Chicago where his father was then United States district attorney He spent nearly six years at school in Germany and France returning to the United States in 1876 President Hayes gave him an appointment to the U S Military Academy in 1878 He was graduated in 1882 among the "distinguished cadets" standing No 4 in his class. Lieut Fitch after one year's service with the Fifth Artillery at Fort Wadsworth N Y was transferred to the Corps of Engineers After completing the post graduate course at the Engineer School at Willets Point, N Y in 1885 he for the next nine years was on duty in different parts of the country as assistant to various engineer officers in charge of river and harbor improvements. In 1895 Capt Fitch was assigned to duty at Memphis in charge of Mississippi River improvements from Cairo to the mouth of White River In 1897 he was on duty again at Willets Point, N Y commanding Company C Battalion of Engineers, and as instructor of military engineering at the Engineer School During the war with Spain he served throughout the Cuban campaign, first in command of his company later as major of volunteers on Gen Lawton's staff and then in command of the Battalion of Engineers. Since the war he has been stationed in succession at St. Louis as secretary of the Missouri River Commission at Oswego in charge of the harbor improvements on Lake Ontario and at Little Rock in charge of the improvement of the Arkansas White Black, and other rivers In 1906 Major Fitch was assigned to duty at Duluth where he now is, in charge of the harbor improvements on Lake Superior He was promoted to a lieutenant-colonelcy in 1908 Col Fitch has written aside from his official reports, a technical engineering paper on "Lock and Dam Construction on the Upper White River Arkansas" first printed by the War Department in 1904, and copied somewhat condensed in the issue of Engineering Contracting for May 9th 1906 He has translated for the Military Information Division of the General Staff various papers on military topics from the German French, and Italian Col Fitch is a member of the American Society of Civil Engineers, also of the University Club of New York city

Fatty Lubricants

There are cases in which natural fats with or without admixture, still form the best lubricants A good lubricant for swiftly moving and lightly loaded parts of machines is made of equal weights of graphite and tallow, very thoroughly mixed An excellent lubricant for piston rods is made by melting together 40 parts of neutral wool grease and 10 parts of ceresin (a derivative of ozokerite or mineral wax) and add [illegible] to the hot mixture 25 parts of pure mineral oil [illegible] parts of graphite. Good results have recently [illegible] obtained with "calypsol" which is alleged to be [illegible] vegetable fat free from acid and of high [illegible]. A solid lubricant should be light colored homogeneous free from acids alkalies resins and mechanical impurities and should not contain more than 2 per cent of water or more than 10 per cent of lime soap an ingredient which is added to some of these mixtures

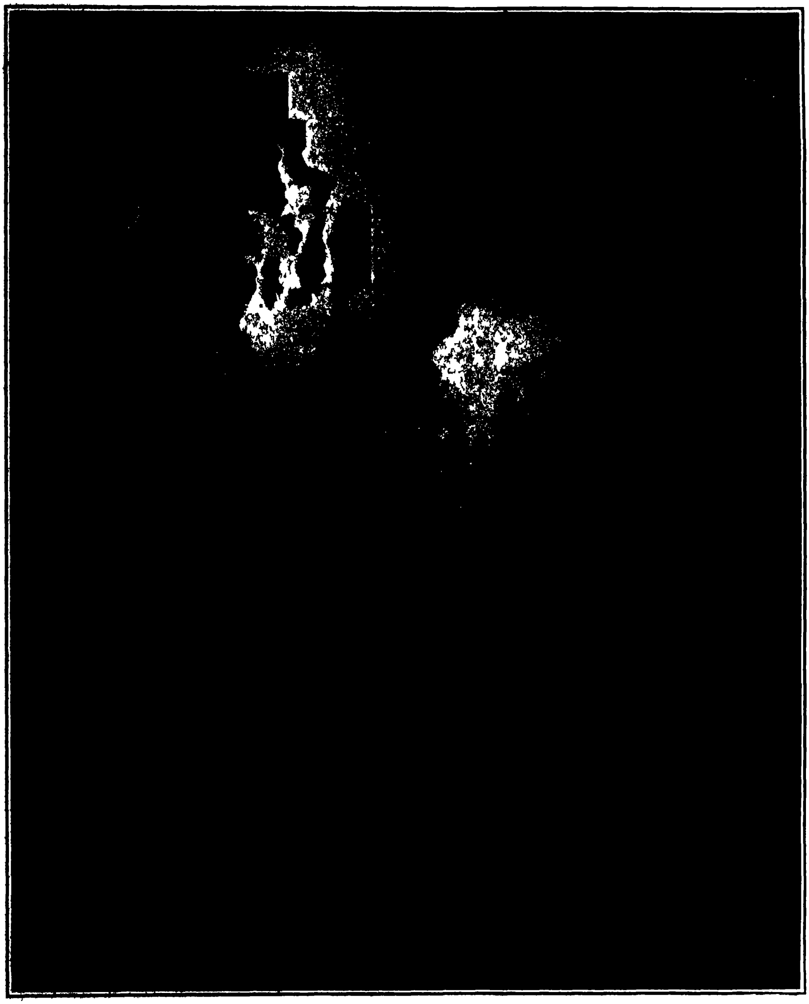
◆

Traube has devised a very simple process for purifying crude alcoholic spirits The process consists essentially in adding to the crude spirit a strong solution of ammonium carbonate or ammonium sulphate The mixture separates into two parts and if the temperature and the concentration of the ammonium salt are properly chosen all the impurities are accumulated in the upper portion.

THE COTTON INDUSTRY OF THE UNITED STATES.

The Bureau of the Census is constantly issuing bulletins which give the facts relating to various industries without waiting until the decade has been finished Thus the figures for textile manufactures are for the year 1905 The figures relating to manufactures of cotton are most interesting and we have given some of them in graphical form The annual cotton crop (year ending June 30th 190) was 13 565 88 bales representing a gross weight of 6 934 981 731 pounds Of this amount 4 304 848 903 pounds was exported In the same period only 60 508 548 pounds of cotton was imported.

The manufactured articles made in the year 1906 are



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THE MAGNITUDE OF THE COTTON INDUSTRY FROM COTTON BOLL TO FINISHED PRODUCT shown in our comparison The area of Rhode Island is 3 872 000 000 square yards, while the woven cotton goods produced in the United States during the year was 5 070 028 520 square yards This is represented by a cotton boll reproduced in scale with the map of Rhode Island An actual cotton boll was used as the basis of the drawing The figures can be analyzed as follows

Kind	Square yards	Value
Aggregate value		$442 451 218
Woven goods total	5 070 028 520	120 382 307
Plain cloths for printing or converting total	1 818 216 172	80 311 012
Not finer than No 28 warp	812 249 764	32 945 094
Finer than No 28 warp	1 005 966,408	47 365 918
Brown or bleached sheetings and shirtings	1 172 309 182	91 251,376
Ginghams	102 310 132	22 471,867
Ticks denims and stripes	260 375 180	24 707 578
Drills	104 735 703	12 598,063
Twills and sateens	368 142 513	23 704 305
Cottonades	25 702 346	2 098 971
Napped fabrics	330 808 140	20 108 313
Fancy woven fabrics	306 254 085	28 480 342
Corduroy cotton velvet and plush	10 014 530	4 709 573
Duck total	122 601 212	17 005 082
Sail	9 588 510	1 540 745
Other	113 014 601	15 465 237
Bags and bagging	57 667 661	3 651 712
Mosquito and other netting	30 232 018	701 963
Upholstery goods, total	65 502 212	12 111 668
Tapestries (piece goods and curtains)	9 665 000	4 242 508
Lace and lace curtains	53 311 223	7 208 314
Chenille curtains	268 168	93 100
Other including covers	2 207 816	567 785
	Pounds	
Yarns for sale	161 472 753	70 885 387
Sewing cotton	17 163 741	15 043 043
Twine	6 176 573	1 282 017
Tape and webbing		49 546
Batting and wadding	10 165 850	1 173 343
Waste for sale	217 315 102	10 040 037
Other products of cotton		2 605 801
All other products		11 979 747

In our engraving the circles around the earth represent the distance covered by the different cotton goods manufactured in the United States in the year specified The quantity of some of the goods manufactured is so great that it was necessary to make the strips many yards wide

Some idea of the magnitude of the industry may be obtained when it is stated that there were in the same year 23 155 613 spindles in cotton mills

The capital of the 1 077 establishments was $605 100 164 There were 310 458 wage earners and 6 738 salaried officials clerks etc The total amount of wages paid was $94 377 696 and $9 911 767 for salaries the cost of the materials used was $287 047 648 and our table shows products worth $442 451 218 This is indeed a vast industry and one which has enabled us to successfully compete in the markets of the world

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Tetanus and the Glorious Fourth.

BY JOHN B HUBER, A M M D

A wholesome tendency is now making for the elimination of such features of Independence Day as have especially endangered the lives of the young—and this while in no wise suppressive of normal enthusiasm We need not go the length of some who have rather hysterically termed this holiday the Bloody Fourth with its annual holocaust of carnage Nevertheless, it is certainly the part of wisdom and of humanity to plead for less detonating celebrations than have obtained in the past In Continental countries such occasions are commemorated quite adequately and just as heartily as with us by means of fêtes and other rational ceremonies. For adult patriotism oratorical explosions suffice, but these for reasons we need not probe are not sufficiently satisfying to the youth In the legitimate interests of boyhood some reconcilement of patriotism and prophylaxis is essential

The citizen is probably unfamiliar with the extent to which children have died from Independence Day tetanus or lockjaw than which there can be no more painful or cruel death nor is it generally realized how many other children have survived wounds received on that day without having contracted tetanus who have nevertheless been dreadfully maimed or disfigured for life It is related that these celebrations of the last six years show for the whole country a grand total of 29 296 killed and wounded The American Medical Association has taken up the matter and its Journal reports that in 1903 there were 415 cases of Fourth of July tetanus In 1904 105 cases, in 1905 104 cases in 1906 89 cases. In 1907 there were 55 recorded cases These cases were brought about in more than sixty per cent by blank cartridges in about sixteen per cent by giant fire-crackers, in about four per cent by cannon in about five per cent by firearms in about ten per cent from powder etc The decrease in casualties has thus been progressive since 1903 And Baltimore was I believe the pioneer in the agitation which is resulting so beneficently In that community there is now an ordinance providing that no person shall cast throw or fire any squib rocket cracker torpedo grenade or other combustible fireworks or explosive preparation within the city" nor may any such explosives be made in Baltimore There were in consequence but ten accidents on last Independence Day Philadelphia saturated as it now adays is with worthy and unassailable patriotism, was able for the same day to produce a total of 482 killed and injured Denver, Detroit, Minneapolis, St. Paul, Louisville and Omaha now have ordinances similar to Baltimore's, with the result that no life was sacrificed in any of these cities. In New York, it would seem sundry among our municipal fathers (with interests on the side) have determined that the ideals upon which our republic were founded shall not die for want of fireworks for they will not endure that we shall be surpassed in patriotism

How can we prevent tetanus fatalities arising out of Fourth of July celebrations? The tetanus bacillus is anærobic, and to this property is certainly due the comparative and the fortunate rarity of the disease—despite the fact that the bacillus is very prevalent in many localities This germ thrives only in wounds closed and thus devoid of oxygen whence the term 'anærobic" It rarely traverses the site of an injury—rarely enters the blood and lymph channels. The toxins or poisons generated by it are the virulent factor It has its habitat mostly in earth sometimes in putrefying fluids and manure In many localities as in parts of Long Island it is ubiquitous. Tetanus is said to be curiously endemic in a region from one to five miles in extent near Atlantic City N J

The infection generally occurs through the introduction of impregnated dirt into wounds sometimes very slight wounds especially of the face hands and feet Most cases as we have noted come about through the discharge of powder in blank cartridges which consist besides the powder mainly of paper Half the remaining cases are due to the giant fire-cracker (not the small kind) The wound may serve for the introduction of germs accidentally present on the skin—a phenomenon readily understood when we consider the normal state of the average small boy's hand

There may be but a mere burn—something quite superficial yet some part of a wound however slight, may become at once impermeably sealed The bacilli may thus secure an implantation in microscopic pockets or fissures In puncture tetanus the germ may be introduced upon the instrument itself as a dirty or rusty nail or the tine of a pitchfork Blank cartridges may be made of germ harboring material Punctured contused or lacerated wounds are much more dangerous than such as are clean cut as with a dagger or a sharp knife Crushing injuries deep lacerations gunshot wounds wounds beneath the skin the fat or the fascia and especially where dirty clothing has been introduced into torn flesh are most to be feared

Obviously then the toy pistol and the giant firecracker must be forbidden children Practically no cases of tetanus have developed (at least I have not seen a report of any) from Roman candles torpedoes paper caps small fire-crackers or display pieces In order that no undue fear may arise we note that for the 89 cases of tetanus developed in 1906 there were 979 blank-cartridge wounds Thus tetanus by no means follows as a matter of course from wounds incurred on Independence Day

The symptoms of this dreadful disease may not manifest themselves until an incubation period of a fortnight has elapsed after the injury Then may appear rigidity of the neck and jaws difficulty in chewing and swallowing chills high fever asphyxia spasm of various muscles rapid pulse, profuse sweating opisthotonus—dreadful suffering

Immediately a child sustains an injury of the nature we have considered a physician is to be called who will administer an immunizing dose of tetanus antitoxin Such a timely dose will almost surely protect against the development of the symptoms but its efficacy decreases with the time lost in administering it Before the use of this serum, death followed in at least 80 per cent of tetanus cases. All health departments now have this antitoxin available for immediate use upon application The Health Department at Albany has advised the health officers throughout New York State to apply to it for supplies in order that they may be prepared to provide local practitioners without delay Its Bulletin states 'An immunizing dose of antitoxin is an almost certain means of preventing tetanus infection and intoxication, so far as we know, no case of lockjaw has developed in this country among those who have received an immunizing dose of this serum" In any event the secretion of the wound may during the incubation period be scrutinized by the microscopist for the possible presence of the tetanus bacillus its absence after several examinations should greatly allay fear of the disease.

◆

Retirement of Secretary Wilson.

James Wilson Secretary of Agriculture will retire from office in December, and will probably be succeeded by Charles F Scott at present Representative in Congress from the Second District of Kansas and chairman of the House Committee on Agriculture.

Mr Wilson has realized his ambition of serving in the Cabinet for a longer continuous term than any other man He entered the Cabinet in President McKinley's first term He is now nearly seventy-four years of age. To him are due many important improvements in the administration of the Department of Agriculture, and likewise many new lines of research, the results of which have aided farmers throughout the country

◆

The Death of Egbert P. Watson.

Mr Egbert P Watson, formerly a member of the editorial staff of the SCIENTIFIC AMERICAN, died at Elizabeth, N J, at the age of seventy four, on June 22nd, 1909 In his professional career as an editor and an engineer, Mr Watson displayed a wide engineering knowledge and keen editorial judgment. After he severed his connection with this paper he founded a periodical of his own called The Mechanical Engineer, and continued its publication for sixteen years.

Mr Watson was an engineer of the old school, that is, his engineering knowledge was acquired mostly by hard work in the shop, although he was an omnivorous reader and well versed in engineering literature Long after he severed his connection with this journal he continued to contribute to its columns occasional engineering articles which were distinguished by the sound and practical information that they conveyed Mr Watson always took pride in the fact that he drove the first bolt in the "Monitor" the civil war ironclad He was a past vice-president of the National Association of Marine Engineers, and was for many years a member of the Marine Engineers' and Architects' Association

◆

Death of Orrin S Wood.

Mr Orrin S Wood, well known in this country as a pioneer telegraph engineer died at Turner, N Y., on June 22nd 1909 at the advanced age of 91 years. Mr Wood had the distinction of superintending the construction of the first telegraph line between New York and Philadelphia in 1845 and of opening the first telegraph office in New York city at Hanover Street and Exchange Place His interest in telegraphy antedates these achievements, however, for in 1844 he became an operator on the original telegraph line between Baltimore and Washington after having studied telegraphy under S F B Morse himself Mr Wood helped to build the Albany Buffalo line and the telegraph line connecting Buffalo, Niagara Falls, Toronto, Montreal and Quebec, besides constructing a telegraph system northwest of Chicago, which now forms part of the Western Union lines.

◆

$100 Prize for a Fire Escape.

At the National Industrial Exposition to be held in Toronto Canada, from August 28th to September 14th fire escapes are to be exhibited under the auspices of the Commercial Traders Association of Canada The association will give a prize of One Hundred Dollars to the inventor of the best fire escape The selection will be made by the Ontario government and in all probability the successful fire escape will be placed in many hotels in the Province of Ontario The conditions of the contest may be obtained by addressing the Commercial Traders' Association of Canada, Toronto Canada.

◆

The Current Supplement.

The wonderful results obtained by the great masters of the art of piano playing can also be obtained to a certain extent by mechanical means in the modern piano player Mr John F Kelly describes in the current SUPPLEMENT No 1748 the construction of these piano players and shows how they have evolved from crude forms. Mr John A Mathews's paper on the new automobile steels is concluded Among the numerous fads and fancies of the house furnisher of to-day none is more quaint and interesting than the decorative use of the vari-colored bottles and flasks of many shapes and sizes that are relics of one of the oldest enterprises of this country Ada Walker Camehl writes interestingly on this subject, and illustrates her article with pictures of curious bottles. The manufacture of nitrates from the atmosphere by means of the Birkeland Eyde process is set forth by Sam Eyde What a very small telescope will do is excellently described by Arthur Mee Prof C Doelter writes on the influence of radium and ultra violet rays upon the color of minerals. F Hartmann contributes a good technological article on gilding

◆

During Mr Andrew Carnegie's recent visit to Paris he was given an official reception at the University It will be remembered that Mr Carnegie donated a considerable sum to this institution so as to enable it to found a special laboratory for researches upon radium, to be carried on by Mme. Curie. During the reception Mr Carnegie was presented with a medal commemorating his generosity to the University. In a conversation with President Fallières, he made known his intention of establishing an institution such as exists in America and England for rewarding heroic actions, and proposes to donate a million dollars for this purpose.

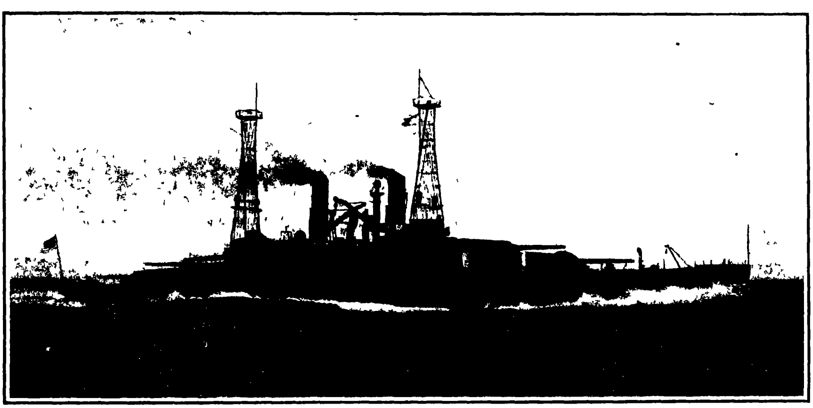
THE "MICHIGAN"—OUR FIRST "DREADNOUGHT"

The first "Dreadnought" to be completed for the United States navy is the "Michigan," which, with her sister, the "South Carolina," was authorized by Congress March 3rd, 1905 In the act of authorization the displacement of these ships was placed at 16 000 tons, which is that of the Connecticut" and 'Kansas" class. It was intended to provide these vessels with the same armor and armament as the ships of those classes but before the construction was far advanced, it was decided to give them as much as possible of the 'Dreadnought" characteristics and the plans were changed accordingly

The "Michigan," which was built by the New York Ship Building Company, Camden, N J was recently taken to the government course at Rockland, M for her standardization trials, and on June 9th during five runs at maximum speed she averaged just under 19 knots per hour, or to be exact 18 976 knots On the fastest run over the measured mile she reached a speed of 20 01 knots

The accompanying photograph was taken of this fine vessel when she was running at a speed of over 19 knots and it serves to show very clearly the special characteristics of the ship notably her two lattice-work fire-control masts and her main battery of eight 12 inch guns carried in four turrets.

The 'Michigan' is a 'Dreadnought in everything except size and speed the displacement being from 3,000 to 4,000 tons less than that of the typical 'Dreadnought" of to-day and her speed about two knots less In respect of protection and armament, however, she is fully qualified to lie in line of battle with the heaviest ships of the "Dreadnought' type Although she carries but eight 12 inch guns as against ten carried by the British ships, the position of her turrets all of which are on the center line, enables her to deliver the same weight of fire on either broadside namely eight 12 inch guns. Speaking of the penalties paid by the 'Michigan' on account of her small displacement it should be mentioned that it was necessary to cut down her freeboard aft and lower the after two turrets eight feet below the positions at which they are carried on our later "Dreadnoughts" of larger displacement.



Copyright 1909 by N L Stebbins.

Displacement, 16,000 tons **Speed,** 18.97 knots. **Coal supply,** 2,200 tons **Armor:** Belt, 11 inches side armor 10 to 8 inches turrets 12 to 8 inches deck 1½ to 3 inches **Armament:** Eight 45-caliber 12-inch, twenty two 3 inch **Torpedo tubes,** two submerged 21 inch **Complement,** 869

OUR FIRST "DREADNOUGHT," THE "MICHIGAN," MAKING 19 KNOTS ON HER TRIAL TRIP SISTER SHIP "SOUTH CAROLINA."

The "Michigan" is 450 feet long between perpendiculars, 452 feet 9 inches over all 80 feet 2½ inches in breadth at the water line, and on a mean draft of 24 feet 6 inches has a displacement of 16 000 tons Her full load displacement is 17 617 tons. The speed called for by the contract is 18 5 knots which as we have seen above, was exceeded She is driven by twin screw, reciprocating engines of 16,500 horse-power and she has a maximum bunker capacity of 2,200 tons

The armament consists of eight 45-caliber 12-inch guns mounted in four turrets. The foremost pair are 25½ feet above the water. Back of these are two guns in a single turret, which fire above the roof of the forward turret and are carried at a height of 33½ feet above the water The superstructure occupies about one-third of the vessel's length amidship. It contains the conning tower and two smokestacks, the two military masts and two boat derricks, placed abreast of the smokestacks Within the superstructure and carried on the spar deck is a battery of ten 3 inch guns for torpedo defense and twelve other 3 inch pieces are mounted on the superstructure bridges and elsewhere on points of vantage throughout the ship

Abaft of the superstructure are the remaining two 12-inch gun turrets one mounted on the main deck at a command of about 17½ feet above the sea and ahead of this another turret with its guns carrying at a height of 25½ feet above the water This disposition of main armament gives a broadside of eight 12 inch and a fore and aft fire of four 12 inch

The armor plan of the Michigan shows a water line belt 8 feet wide tapering amidships from 11 inches in thickness at the top to 9 inches at the bottom The belt reduces gradually to a thickness of 4 inches at the ends of the ship Above the main belt and extending from the forward to the after barbette is another belt of armor 10 inches thick at its lower edge 8 inches thick at its upper edge and 8 feet in width The barbettes for the 12 inch turrets are from 10 to 8 inches in thickness The turrets themselves have 12 inches of armor on the sloping port plate and 8 inches on the sides and at the back. The protective deck is 1½ inches in thickness amidship and forward and 3 inches in thickness in its after portion The big guns are manipulated by electric power as are also the ammunition hoists The torpedo equipment consists of two submerged torpedo tubes for the discharge of the new 21 inch turbine driven torpedo

At the present time we have completed or under construction for the United States navy eight Dreadnoughts' The Michigan and South Carolina of 16 000 tons carrying eight 12 inch guns the Delaware' and North Dakota of 20 000 tons carrying ten 12 inch guns the Florida and Utah ' of 21 825 tons mounting ten 12 inch guns and the Wyoming and 'Oklahoma of 26 000 tons each mounting twelve 12 inch guns

◆

A Dirigible Balloon Made in Sections.

A German engineer named Weissenburger has constructed a model of a dirigible balloon which can easily be taken apart for transportation This possibility is of great value as often the transportation of the balloon is made necessary by a premature landing or other cause The model which is about 13 feet long consists of eight sections each of which is in the form of a cylinder with hemispherical ends, and can be collapsed like an umbrella by turning a handle. The convexities of both ends of the section are directed forward, so that when the sections are put together the rear end of one closely embraces the forward end of the next The sections are made entirely alike, so that a damaged section can be replaced by a reserve section Each section possesses its independent gas bag, air ballonet, frame, and points of attachment to the car and steering apparatus, and each section can be used as a small captive balloon for military purposes It is also possible to transform a section quickly into a small dirigible by installing a little motor in its car For this purpose the section is provided with a blower for distending the ballonet and with vertical and horizontal rudders Two sections without frames may be combined to form a larger non rigid airship The car of the entire airship contains as many sections as the balloon so that each partial balloon possesses its own car with the exception that a special division of the car is reserved for the machinery In the estimation of the inventor the sections can be put together by a balloon corps in two hours

◆

Saponification and Pancreatic Juice

In making soap and candles the natural fats are saponified or resolved into their component parts fatty acids and glycerin by various methods including the action of alkalies lime sulphuric acid superheated steam etc

Haller has devised a method of effecting saponification by means of methyl or ethyl alcohol and Connheim and Nicloux have suggested a biological method based on the employment of a diastase which occurs in castor oil beans

Baur has recently proposed the use of the pancreas of animals which contains a soluble ferment capable of resolving fat into fatty acid and glycerin in from one to four days This method has been successfully tested with beef suet and with cocoanut, cotton-seed, maize and palm oils This process if universally adopted in all countries would require 12 000 tons of pancreas annually The abattoirs of the world furnish about two-thirds of this quantity or 8 400 tons In comparison with the employment of the castor bean ferment the pancreatic method effects a more complete saponification which compensates for its greater cost

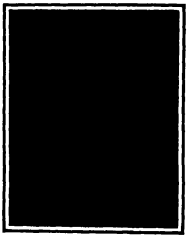
◆

The annual summary of shipbuilding just issued by Lloyd s Register shows that the total output of the world during 1908 (exclusive of warships) appears to have been 1 833 286 tons (1 706 179 steam 127 107 sail) According to the latest returns received by Lloyd s Register the tonnage of all nationalities totally lost broken up etc during the twelve months amounts to about 794 000 tons (557 000 steam 237 000 sail) The net increase of the world s mercantile tonnage at the end of 1908 is thus about 1 039 000 tons Sailing tonnage has been reduced by 110 000 tons while steam tonnage has increased by 1 149 000 tons Of the tonnage launched during 1908 the United Kingdom has acquired over 30¼ per cent Of the total merchant tonnage output of the world during 1908 50¾ per cent was launched in the United Kingdom but if only sea going steel steamers of 3 000 tons gross and upward be taken into account thus excluding vessels trading on the North American Lakes—out of the total of [illegible] such steamers of 1 050 741 tons launched in the world over 63 1 3 per cent of the tonnage was launched in the United Kingdom

A MUSEUM TO ILLUSTRATE THE DEVELOPMENT OF MATHEMATICS

BY HERBERT T. WADE

As an interesting and important part of the study of the history of mathematics it is essential to consider the various means that have been employed in the application of this science to everyday life. From the times of Babylon to the present day there has been an interesting succession of ingenious and useful devices and instruments of a very practical nature which when considered together are remarkably striking in illustrating the development of what is usually regarded only as a most abstract science. Such a collection has been assembled by Prof. David Eugene Smith of Teachers College, Columbia University, and recently it has been on exhibition in the Educational Museum of that institution. Containing as it does many objects of great interest to the archæologist, metrologist, surveyor and engineer, yet it is in its relation to the historical development of the science of mathematics and its great influence in bringing out this development to the student that the exhibition possesses its highest value. With this end in view Prof. Smith has accumulated a collection of mathematical instruments, weights and measures, sun dials and other devices for time measure, mathematical manuscripts, early printed works, an extensive collection of portraits and autographs of prominent mathematicians and curios gathered from many corners of the world, some of the most interesting and significant of which have been specially photographed for the SCIENTIFIC AMERICAN.



A mediæval astronomer using an astrolabe

Reproduction of a page of [illegible] 15th century work

Astrolabes made by Bernardinus Sabeus of Padua (Italy) 1558 and by an unknown Italian craftsman between 1450 and 1525

One of the most important and fundamental applications of mathematics has been to surveying and astronomy, and just as soon as trigonometry was developed to a point where it was available for practical use there was need of instruments for the measurement of angles and for realizing or imitating the relative movements of the celestial bodies. Now for measuring angles in the early times a device known as a cross staff was used, where a movable transverse piece could be adjusted along the length of a wooden staff so that by sighting from one of its extremities over the end of the cross piece and then laying off the angle thus formed by the line of sight with the staff itself, a rough angular measurement could be made. Various improvements gave the cross staff and the back staff, but the first really serviceable instrument was the quadrant, which was the ancestor of our modern and indispensable sextant. A good specimen of a quadrant of Tyrolean workmanship, and dating back to about 1600, is contained in the collection and is here illustrated. The alidade or movable bar carries two small transverse pieces pierced with sight holes, and is so pivoted that it can be moved over the graduated quarter of a circle, which gives to the instrument its name. The quadrant could be used for measuring both vertical and horizontal angles, and naturally lent itself to determining the elevation of the heavenly bodies in astronomy and navigation, so that by the middle of the sixteenth century it was accepted as a necessary nautical instrument as well as used on land wherever trigonometry was applied to surveying. The Italian textbook "L'Uso della Squadra Mobile Opera di Ottavio Fulli. In Trento MDCCLII," a page of which is shown in the illustration, gives the actual directions for the use of the quadrant in measuring the height of the tower by the familiar trigonometrical principles involving the measurement of linear distances, here by pacing, and the determination of angles.

Quadrant of Tyrolean workmanship dating from about 1600

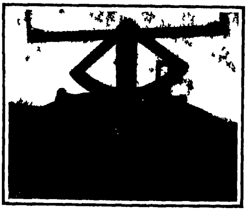
It was the common trigonometric instrument of mediæval times and its use is shown in the accompanying illustration

Using the quadrant to measure the altitude of an inaccessible tower

Reproduction of a plate from an 18th century treatise on the quadrant.

Practically contemporary with the quadrant was the astrolabe, where the entire circle was employed, and where by the use of an alidade and a divided circle or limb the angular distance between two stars could be determined, leading to the deduction of the motions of the planets by the astronomers and astrologers of the middle ages. The use of the instrument is indicated by the accompanying reproduction of a page from an eighteenth century scientific treatise while

(*Continued on page 15*)



Early 19th century German surveying instrument. Made by Wiskemann of Meiningen

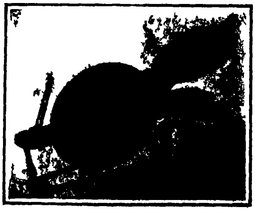
Early surveying instruments.

Surveying level (German)

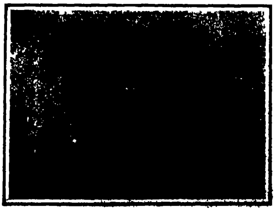
Italian squadra. Cannon level

Surveyor's compass

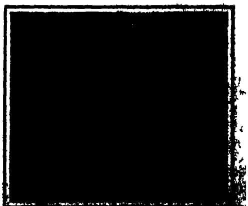
Celestial sphere of Italian workmanship dating from the 16th century.



Chinese sun dial of the 18th century from Peking.



Japanese surveying instruments of the early 19th century and Japanese surveying textbook



[illegible] scales of the 18th century and various sets of weights.

A MUSEUM TO ILLUSTRATE THE DEVELOPMENT OF MATHEMATICS.

A HUGE FILTERED WATER RESERVOIR FOR LONDON

BY THE [illegible] CORRESPONDENT OF THE SCIENTIFIC AMERICAN

The maintenance of an adequate water supply for the constantly expanding English metropolis is a problem of supreme importance and one of no little difficulty. The main sources of supply are the River Thames at a point well above tidewater, the river Lea, and wells sunk into the solid chalk. Recently the facilities for supplying water have been appreciably improved by the erection at Honor Oak in the southeastern suburban area, of a huge covered in reservoir, the largest of its type in the world for storing filtered water, the capacity of which when full is 58,000 000 gallons.

The necessity of a new reservoir was recognized as far back as the early nineties. Not until 1898 was work begun by the local water supply company. In that year a large brick making plant was erected on soil eminently suited to brick making. The result of this development was rendered obvious during actual constructional work since the brick material was available on the spot and delays as well as cost of transport were avoided. The saving thus effected may be readily realized when it is considered that upward of 16 000 000 bricks were utilized in the building of the reservoir. At the same time the brick plant offered an economical solution of the problem of disposing of the greater part of the excavated material for the foundation of the reservoir etc which material aggregated 173 000 cubic yards.

After all the water-supply companies of London were subsequently consolidated into the Metropolitan Water Board the undertaking was rapidly completed. The undertaking was designed and carried out under the supervision of Mr J W Restler M.Inst C E the deputy engineer in-chief of the Metropolitan Water Board to whose courtesy we are indebted for the accompanying illustrations and for much information.

Interior, showing principle of dividing the reservoir into bays 21½ feet square

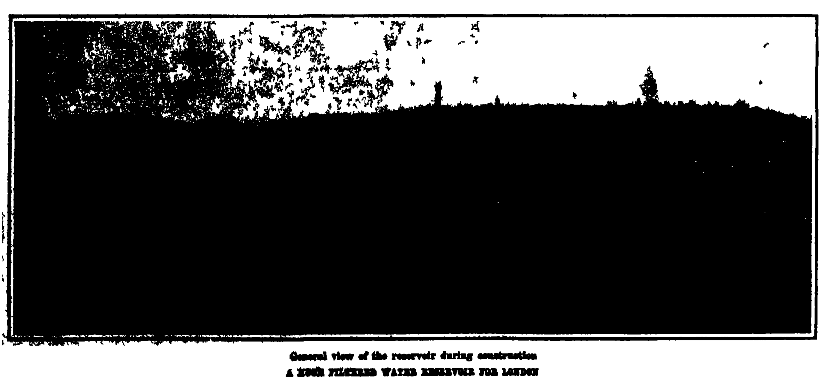
It is the primary purpose of this reservoir to maintain a low pressure supply throughout the metropolitan area on the southeastern side of the Thames. But if occasion should demand it can be dispatched by means of mains under the river to the northern territory. The maximum water level of the reservoir is approximately 144 feet above ordnance datum. The depth of water throughout the greater part of the structure is about 21½ feet but in a part of the north eastern section it reaches a depth of 34 feet.

The reservoir is divided at right angles into four sections each of which is independent of the others so that any one may be emptied when desired for cleaning without interfering with the service suitable appliances being provided for diverting the water from the supply main into one or other sections. The building is erected on a natural clay formation the flooring being of solid concrete forming inverted arches crossing one another at right angles. From the apex of each groining spring piers of solid brick work of cruciform section to carry a brick roof comprising a series of segmental arches running parallel the whole length of the structure with segmental jack arches at right angles carried from pier to pier throughout the series. The reservoir is therefore divided into a series of cells 21 feet 6 inches square from center to center of the brick piers the thickness of the brickwork of the latter being 18 inches with a width across of 4½ feet. Down the centers of the inverted arched floor extend drainage channels communicating in a well near the intersection of the reservoir into the four sections while at the actual point of intersection of the division walls is a circular valve chamber 24 feet in diameter extending from the bottom to the roof of the building and into which lead the mains for supply intercommunication with the four sections and draw off these pipes being of 42 inches diameter and fitted with 36 inch valves operated from a valve house above.

In addition to the brickwork for the arched roofing there is a 6 inch outer covering of concrete finished with clean cement upon which is distributed a thick layer of clay and 6 inches of mold originally cleared from the site so as to present a flat level top surface. At frequent intervals 6 inch air pipes are distributed over the bays for ventilation and admission and escape of air during the respective processes of emptying and filling the reservoir.

The two division walls which run at right angles and divide the reservoir into four sections are cambered back to back with the intervening space filled with concrete. The outer walls are of concrete with brick lining ample precautions having been taken to bond the two thoroughly together. The thickness of the retaining walls varies from 16 feet to [illegible] feet at the base and each bay is provided with a buttress reaching in most cases to the first pier. In those places where the pressure is the greatest the buttresses for the retaining wall are carried back to the fourth bay from its face. Around the outside of these retaining walls a puddled clay wall 3 feet thick is provided the puddle being taken well down into the London clay and rendered thoroughly water tight by careful tamping. This wall is carried up to and connected with the layer of clay extending over the entire roof of the structure. On the northern and parts of the eastern and western portions where the top of the reservoir projects above the natural surface of the ground an earthen embankment is provided which embankment is composed of alternate layers of [illegible] and burnt ballast of [illegible] inches and 4 inches thickness respectively and with a slope ranging from [illegible] 2 to 3 [illegible] to 1.

The reservoir measures 8[illegible]4 feet in length between the walls and has a maximum width of [illegible]87 feet. The total area covered approximates 14¼ acres the actual water area being a little over 10 acres. The supply is drawn from the 42 inch main which brings the filtered water from the pumping station at Hampton some 17 miles distant. The outlet pipe is of the same diameter. The supply can be augmented from a deep well pumping station which has been erected on the site and from which a large quantity of water can be drawn. This well has a diameter of 11 feet and is sunk for a depth of 300 feet the lower half of which is through chalk. Headings have been driven into the latter in all directions to a total length of 3 400 feet. The water is raised by two sets of three-crank vertical triple-expansion engines coupled to deep well pumps having cylinders of 18 inches bore by a stroke of [illegible] feet. The water thus obtained in addition to being discharged into the adjacent reservoir can be delivered into mains feeding two other reservoirs in the vicinity. The total cost of the enterprise has been $1 200 000.



General view of the reservoir during construction

A HUGE FILTERED WATER RESERVOIR FOR LONDON

◆

Another Substitute for India Rubber.

A G Inrig has patented in Great Britain and Germany a new process for making a substitute for India rubber. The materials used are animal refuse capable of yielding gelatin oils sulphur bromates and sodium stannate the addition of the last named salt being the distinguishing feature of the process. The proportions recommended are animal refuse 100 parts water [illegible]0 parts oil 20 to 6[illegible] parts. These ingredients are stirred together for about an hour and then 1 per cent of potassium bichromate and 1 per cent of sodium stannate are added. The mixture is then heated to about 1[illegible] deg F and kept at this temperature about [illegible] minutes or until the previously liquid mass becomes pasty in which condition it is poured into molds. A harder and tougher mass is made by adding [illegible]0 per cent of oil 1 per cent of sodium stannate 1 per cent of potassium bichromate and [illegible] 10 per cent of sulphur and heating the mixture to 2[illegible] deg F.

THE HEAVENS IN JULY.

BY HENRY NORRIS RUSSELL, PH.D.

HERCULES, which is the constellation represented in the initial of this sentence, while not as brilliant as some others, is one of the most characteristic figures in the summer sky Its most distinctive configuration is a quadrilateral of third magnitude stars shaped like the keystone of an arch which at our hour of observation is almost exactly overhead, and which can always be easily found since it lies about one-third of the way from Vega toward Arcturus. The rest of the constellation can be easily made out with the aid of the map Several of its individual stars are noteworthy The star α in the hero's head, is one of the reddest of the brighter stars, and shows an especially fine banded spectrum—an evidence of relatively low temperature, and like many such stars, varies irregularly in brightness. It is also double having a green companion, visible with a small telescope ζ is also a fine double, having a companion about 1/20 of its own brightness, which revolves about it in a period of 34 years. When the two are closest, they can hardly be separated by the greatest telescopes but when they are farthest apart (as is nearly the case at present) the comparison can be seen with telescopes of moderate aperture though still too difficult for small ones of three inches or less.

Another interesting system is μ which has a faint companion 30 sec distant which shares in the large proper motion of its primary and is itself double, with a period of about 45 years

Both these last two systems are tolerably near us their distances being about 20 and 30 light years according to the best determinations

Still more interesting to the telescopic observer is the great star cluster (one of the finest in the heavens) which lies almost exactly on the western edge of the "keystone between the stars ζ and η it is clearly visible in a field glass as a spot of light with two small stars near it, but it requires much greater instrumental power to show the individual stars of which the cluster is composed

There are thousands of them, scattered near the edges but condensed to an almost continuous blaze of light at the center—a very impressive spectacle

With an instrument which is not powerful enough to show the separate stars, the cluster is still easily visible and looks nebulous, i e, hazy and without sharp boundaries If it were removed to a dozen times its present distance, it would present this appearance in our largest telescopes.

It is therefore natural to ask, Are not the numerous nebulæ of all sizes and shapes, which can be seen, or better photographed, in all parts of the sky, simply star clusters so distant that the separate stars cannot be seen?

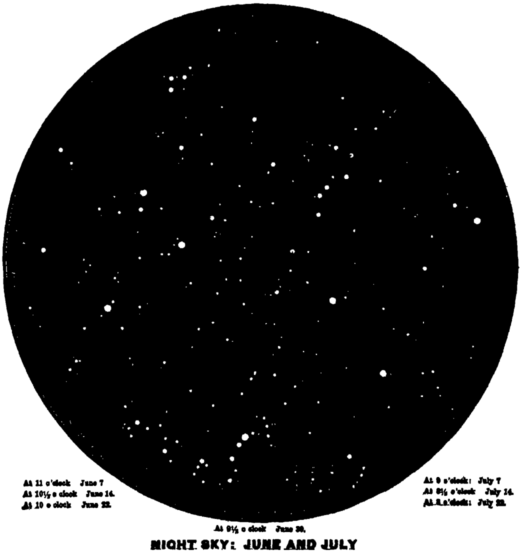
For an answer to this, we must appeal to that clue to many a riddle of the universe, the spectroscope

It is well known that a spectrum showing bright lines is due to glowing gas, while a bright spectrum crossed by dark lines is given by a glowing opaque body surrounded by a gaseous atmosphere—in other words, a star

Now the nebulæ may be divided into two classes. Some, like the great nebula of Orion, are conspicuously green in color, others, like that in Andromeda, are white Those of the former class show a spectrum of bright lines, which proves that they are composed, or rather that the luminous part of them consists of, certain gases—hydrogen, helium, and others not yet identified. This has been known for forty years. But the white nebulæ, among which are to be counted all those remarkable objects, the spiral nebulæ, have till very recently defied investigation. They are so faint that nothing can be done with them visually, and photography demands very long exposures. One or two fairly successful plates, obtained by different observers, showed a continuous spectrum crossed by traces of dark lines, but the matter was still rather uncertain till the publication of some results recently obtained at the Lick Observatory by Mr. Fath. Using a specially designed instrument and very long exposures (continued for several successive nights) he has obtained photographs of the spectra of a number of white nebulæ, which are of the highest interest. The results of the earlier observers are confirmed and extended The great nebula of Andromeda, for example, shows a spectrum crossed by dark lines, such as would be given by a cluster of stars most of which were like the sun. Others show lines more like those in the spectrum of Sirius, and others a combination of dark and bright lines, as if they were composed both of stars and of luminous gas.

A number of star clusters, photographed for a test, showed clearly the dark line spectrum predicted by theory It seems therefore probable that these white nebulæ are really star clusters of immense size at enormous distances. It will not do to speak too positively, for a determination of the parallax of the Andromeda nebula by Bohlin places it quite near us, at a distance less than twenty light years—in which case the component "stars" would have to be mere specks like the asteroids in order not to be directly visible It is possible that this nebula may be an ordinary star like the sun, surrounded by foggy matter of some sort which obscures its direct rays, but is itself visible by reflected light, but further investigation is necessary before this question can be settled

However, it seems almost certain that the Milky Way viewed obliquely from a distance of thirty times its own diameter, would appear as a large oval, and probably spiral, nebula, giving a dark-line spectrum. And it is certainly open, to anyone who chooses, to believe that the Andromeda nebula, or others of the sort, are themselves distant galaxies comparable perhaps to our own, whose countless millions of stars betray themselves to our telescopes, even as those of the Milky Way do to our unaided eyes, merely as a spot of light in the sky.



NIGHT SKY: JUNE AND JULY

[illegible]

South of Hercules is another large constellation, Ophiuchus, represented as a giant carrying a serpent (Serpens). The star α Ophiuchi, which marks his head, is close to α Herculis. His feet are far to the southward, near Scorpio and Sagittarius, both of which are well seen near the southern horizon.

Spica is at a moderate height in the southwest, and Arcturus almost above it. Leo, which contains the bright star Regulus and the far brighter planet Jupiter, is low in the west. Of the remaining zodiacal constellations, Libra is marked by a rather conspicuous pair of stars half way between Spica and Antares, and Capricornus and Aquarius are rising.

The two bright stars in the Milky Way, to the east, are Altair in Aquila and (on the left) Deneb in Cygnus. The still brighter star higher up is Vega, in Lyra.

Ursa Minor and Draco are high up above the pole. Ursa Major is descending in the northwest, and Cepheus and Cassiopeia coming up in the northeast

THE PLANETS.

Mercury is morning star all through the month, and is well observable during the first half of it. He is at his greatest elongation on the 7th, and rises about 3 40 A. M At this time he is on the borders of Taurus and Gemini some distance from any bright star, and so should be easily recognized.

Venus is evening star in Cancer and Leo, setting about 8 40 P M, in the middle of the month On the evening of the 27th she is very near Regulus. Mars is in Pisces, and rises about 10 P M, in the middle of the month. By its close he is within 50 million miles of the earth and very bright.

Jupiter is evening star in Leo, setting about 10 P M toward the middle of the month

Saturn is in Pisces, east of Mars. He is in quadrature with the sun on the 15th, and is due south at 6 A M

Uranus is in opposition on the 11th. At this time he is in R. A. 19h 23m 5s., declination 22 deg 33 min. south—which places him in Sagittarius, about two-fifths of the way from the bowl of the Milk Dipper toward α and β Capricorni and far from any convenient reference stars for the naked eye. By making a diagram of the stars in this region, with the aid of a field glass, he can be identified by his motion, which is 10s. of R. A. to the west, and 20s. of declination southward, per day

Neptune is in conjunction with the sun on the 9th, and is invisible all through the month.

THE MOON

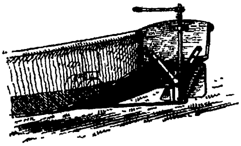
The moon is full at 7 A. M on the 3rd, in her last quarter at 2 A. M. on the 10th, new at 6 A. M. on the 17th, and in her first quarter at 7 A. M. on the 25th. She is nearest the earth on the 9th, and remotest on the 23rd She is in conjunction with Uranus on the 3rd, Mars on the 8th, Saturn on the 10th, Mercury on the 15th, Neptune on the 16th, Venus on the 18th, Jupiter on the 20th, and Uranus again on the 31st.

The *Artocarpus integrifolia*, bread-fruit, or Jack-tree growing wild in Java, gave its name to the locality, *Nangko Djadjar* (*Nangka* = bread-fruit, tree. *Djadjar* = alley or avenue.) The height of the trunk is about 50 feet. The tree is very straight. This plant is not to be confounded with the other bread-fruit (*A. incisa*) which has the leaves pinnatifid; those of *A. integrifolia* has them entire. The fruits are [illegible] inches long and 12 inches broad; the weight is about [illegible] pounds. The flesh of these fruits is [illegible]. The oily seeds are eaten, [illegible] beautiful yellow in color [illegible] cabinet work [illegible] When struck, the wood [illegible] Hence bells are made of it, and pieces of the wood are also used by the watchmen [illegible] giving signals. The [illegible]

TO INSTALL A MOTOR IN A SMALL BOAT

BY MORRIS RADER

Small marine engines can be bought so reasonably now, that many owners of small craft, skiffs, and canoes would install an engine were it not for the trouble and expense of putting on a skag and shaft log. An easy way to overcome this difficulty is shown in the diagram It has been tried by the writer and is a success.



SHAFT BEARING FOR A SMALL BOAT

A shaft bearing is made of iron in the form of a Y, and fastened to the stern of the boat to support the shaft. A longer piece is fastened to this and to the bottom of the boat to protect the propeller A projection of this in the rear will carry the rudder A small shaft log is fitted inside the boat, with the stuffing box on the inside, which can easily be packed from the inside without removing the boat from the water

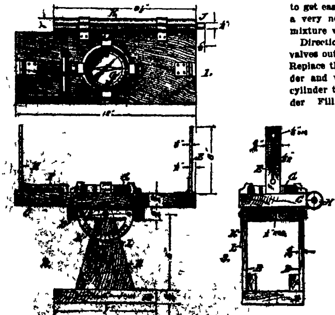
HANDY MAN'S SURVEYING INSTRUMENT

BY AUGUST MERICKE

While the surveying instrument of which a description follows is not very accurate, still if proper care be taken in its construction it will be accurate enough for all ordinary purposes

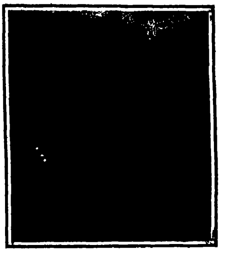
It is built as follows To the base, *A*, of ⅝ inch pine secure the uprights *B*, *B*, of 5/16-inch pine The body, *C*, of ½-inch pine, is hinged to the uprights by a ¼ inch brass rod which passes through a block, *D*, secured to the underside of the board *C* On the body *C* are mounted the two sights *E E* They are made of brass and are hinged so that they can be folded down out of the way when the instrument is being carried The sights must be mounted on the center line of the body Two spirit levels *F* are mounted on the body *C* at right angles to each other The compass *G* is fastened directly over the center of the instrument with four wooden fasteners The position of the N, S, E, and W points can be seen on the drawing

The "telescope," *H*, is mounted on the side of the base and is held in place by the two brass bands. It is made of 1 inch tubing with a ¼ inch piece of brass tubing *J*, fitted in one end for the eyepiece At the other end are two cross hairs. This is used for leveling. The protractor *K* is fastened to the block *D* and is used to measure vertical angles. As the body is moved the protractor turns past the pointer *L* and the number of degrees in the arc it turns can be easily read The instrument is put together with brass screws.



[illegible] DETAILS OF THE SURVEYING INSTRUMENT.

A tripod can be readily made out of three 1¼ inch poles about 4½ feet long, hinged to a top The instrument is fastened to the tripod with a ¼ inch bolt.



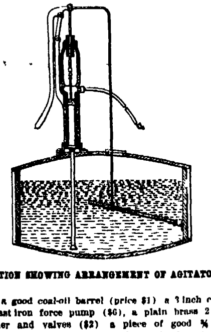
THE SURVEYING INSTRUMENT IN USE.

The instrument cost the writer about $2 50 and up to the present has paid for itself several times on small jobs

A HOME-MADE SPRAY OUTFIT

BY CHARLES A UMOSELLE

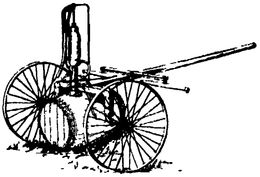
The spray pump described below cost me $11 One of standard make and not so powerful was priced at $45 Any ordinary workman who is handy with tools could put my sprayer together in a day It has proven so valuable to me that I wish to make it known to everybody It was assembled from the following A riding cultivator frame pole and wheels (old scrap iron) a good coal-oil barrel (price $1) a 3 inch cylinder cast iron force pump ($6), a plain brass 2 inch cylinder and valves ($2) a piece of good ⅝ inch hose and a spraying nozzle ($2) Total cost, $11 After putting the above material together I was able to get easily a pressure of 150 pounds per square inch, a very necessary prerequisite to apply the Bordeaux mixture with the right force



SECTION SHOWING ARRANGEMENT OF AGITATOR.

Directions for assembling are as follows Take the valves out of the cylinder of any cast iron force pump Replace these valves with the plain brass 2-inch cylinder and valves Cut off with a hack saw the 3 inch cylinder to the right length to just fill the cast cylinder Fill in the space between cast cylinder and brass cylinder with plaster or cement, being sure that the brass cylinder is in the exact center of the cast cylinder Attach the plunger valve of brass cylinder to the plunger piston of the force pump and couple up the piston to the handle of the pump so as to get a full stroke. As only a small amount of liquid is needed in spraying the object of this reduction of cylinder is to lessen the flow and increase the pressure. The reduction of 3 to 2 halves the flow and doubles the pressure. Mount the pump on the barrel and the barrel on the riding cultivator frame. Make an agitator as follows In the barrel, near the bottom on the end or head of the same, hang with a T-hinge a board made of oak 1 x 6 x 2 feet to swing up and down. Connect the board with the pump plunger by a steel rod so that it will swing up and down with the stroke. The steel rod should enter the barrel through an opening made to pour in the liquid.

I use this machine to spray my hen house with lime and coal oil at the rate of 100 square feet per minute It makes a good job at whitewashing as well and is death to bugs and microbes on my fruit trees.



THE HOME MADE SPRAYER COMPLETE

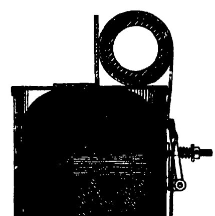
HOW TO MEND GARDEN HOSE.

BY J A SENOSTROM

As the garden hose gets a little old and begins to swell it soon gets out of commission altogether if not attended to.

A simple way to mend it is to wrap the hose with ordinary twine which will make it last a few more seasons As it is no easy matter to wind this cord by hand and get it even and under uniform tension, the writer has for many years used the simple contrivance shown in the accompanying illustration

It consists of an ordinary tin can with a lid into which is put the ball of twine In the center of the bottom make a small hole, through which pass the loose end of the cord Thence let it run down the side of the can through a tension device and to the hose To the cover of the can is soldered a small piece of tin bent to a right angle and forming a guide for the hose. The tension device consists of a short piece of metal with its upper end bent outward forming a fulcrum for a short spring-compressed lever The latter at its lower end has a small hole therein through which the cord is passed A short stove bolt serves to regulate the tension on the lever It will be observed that the cord is pressed against the can by the lever The whole device is now soldered to the tin can



DEVICE FOR WRAPPING GARDEN HOSE

In use the can is turned around the hose, and with the tension properly adjusted the twine will wind around the hose very closely and it will feed the can forward automatically It will make the hose slightly smaller and thus close all the small punctures, through which the water percolates, between the several layers of the canvas By giving the cord a coat or two of some waterproofing it will be found that the hose will last as long again besides it will stand a great deal more pressure than before

A GOOD SUBSTITUTE FOR LEATHER BELTING

An excellent substitute for leather belting can be made from a piece of ordinary fire hose splitting it up the middle into two parts, i e two belts can be made from one piece of hose The writer has seen this done on more than one occasion with perfect satisfaction

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According to a contemporary the largest transmission line in the world is that of the Niagara Syracuse-Auburn line, which transmits 30 000 horse-power over a distance of 163 miles The line in parts is designed to carry 60,000 horse-power

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

SEPARABLE BUTTON.—E C. Kaag, New York, N Y The aim of this invention is to provide a separable button for use on cuffs, collars, garments, and other articles, and arranged to permit convenient separation of the members and easy assembling thereof to unite the members, without danger of accidental disengagement when the button is in use

OVERALLS.—W F Harbour and G A Kellogg, Atlanta, Ga The object of this invention is to provide simple, inexpensive and easily manufactured overalls, having aprons which can be positioned within the overalls so that the latter become similar to ordinary trousers, and in which the apron can be operatively positioned and attached to the suspenders

HAIR ORNAMENT.—A Hochheimer, New York, N Y In this instance the invention is an improvement in ornaments for use for the hair and has in view a device capable of supporting a number of feathers or plumes, and which may be easily applied and secured to the hair at various points and readily detached

NECKTIE HOLDER.—W Downing, Pawling N Y The improvement has reference to necktie holders provided with a cross bar adapted to be passed through the body of a tie, after the latter has been tied in the preferred form on some suitable object such as a pencil a stick of wood, or the like and after the latter has been withdrawn.

LIFE-BELT.—D Boowman Bussum, Netherlands. The invention relates to life belts, the more particular improvement consisting in providing such belts with air compartments adapted to collapse or fold and to normally remain folded but ready to be spread or inflated at a moment's notice when the belt is to be used

METHOD OF FORMING TIPS OF SHOE-LACES.—Mary A Barrett Watchung, N J The object of this invention is to provide a new and improved method for forming tips of shoe laces, in a very simple and economical manner and with a view to render the tip permanent without the use of metallic stiffening, and to allow of giving the tip the same color as that of the body of the shoe lace.

Electrical Devices.

RECEIVER FOR WIRELESS SIGNALING.—H C Catley, Riverside Cal The invention provides an improved wave detector makes the detector self registering and self adjusting within certain limits provides a number of hand-operated adjustments for increasing sensitiveness of the detector connects the detector and its parts in a circuit so arranged as to subject the receiver to current changes and to cause the exaggeration of said changes for the purpose of rendering the indications loud and clear

ELECTRIC TESTING INSTRUMENT.—H G Addie Cresco Iowa. In this case the invention refers to testing instruments and admits of general use but applies more particularly to a type of such instruments used for testing fuses and made in neat form to be carried in the pocket and containing its own supply of current for making the test.

Of Interest to Farmers.

BUTTER MEASURER AND CUTTER.—D F Curtin St Louis Mo. The object of the invention is to provide a device by means of which butter may be cut into prints or blocks and conveniently separated from the rest of the butter in the tub or package, the blocks being of predetermined weight thereby dispensing with the necessity of weighing the butter, as now commonly done

Of General Interest.

MOUTH AND NOSE PROTECTOR.—B Woolf and T W Richards New York, N Y By the use of this invention dust and other flying particles or germs are prevented admission to the nose and mouth. The guard is formed of two separate sections flexibly connected together one adapted to cover the mouth and the other the nose and used in connection with a support which serves to hold both sections in their proper position.

TAPE GRIP.—I D Richardson, Providence, R I In its broadest aspect the invention may be defined as consisting of a rigid bar member of substantially one half of the length of the first and secured to one face thereof, and means including a lever pivoted to said second bar member for clamping the tape between it and the first mentioned bar member

FLAG AND BANNER SUPPORT.—E. H B Lindhorst, San Francisco Cal The support is capable of being raised to or lowered from the truck of a flag pole by means of the customary halyards, and is constructed so that the said support will be maintained at right angles to the pole when there is no breeze and in a breeze will occupy the same position but will wave and turn in conformity with the breeze

FIRE EXTINGUISHING SYSTEM.—C. T Roberts, Tucson Ariz. More particularly the invention pertains to sprinkling systems for mine shafts although it is evident that the system might be utilized equally as well in various other localities. The object is to deliver the water to the system in such a manner as to prevent the burning of the woodwork of the shaft and to prevent the passage of flames from one level to another.

VULCANIZING APPARATUS.—A. F. Conswell, Pretty Prairie, Kan., and J. W. Peckard, Geneva, Neb. This furnace overcomes former difficulties, and automatically controls and regulates the process without attention from the dentist, and when the vulcanizer is brought to proper temperature it closes a sectional oven about the same, so as to maintain even and prolonged heat, and it shuts off the supply of fuel oil, gas, or heating agency, thus saving fuel, time, avoiding mistakes, etc., without attention from the dentist

PAPERING APPARATUS.—O O. Carey, Converse, Ind. More particularly the invention relates to means for smoothing the paper on the wall after it has been hung, and further means for cutting the paper at the base board An object is to provide an apparatus which may be used in paper hanging to smooth the paper in position, to cut the paper off at the base-board, and to press out the edges.

CONCRETE CONSTRUCTION AND METHOD OF PRODUCING THE SAME.—G A. M Liljencrantz, Chicago, Ill, Blocks made by this process may be used in constructing new superstructures over cribs sunk to the proper height, for rebuilding superstructures over old crib work for new pier work where large blocks should be placed on a pile foundation sawed off at a suitable height for docks or rivers where the bottom consists of solid rock; for bridge abutments or intermediate piers, for retaining walls, dams, and other heavy structures, where the cross-section and base must be of considerable magnitude and would make the work very expensive if of solid concrete.

AUTOMATIC SPEED-CONTROLLER.—C E Palmer, Spokane Wash. When adjusted the device may remain in position for use as a means of reaching the ground in case of fire, or for other purposes. As a fire escape, the person may cling to the rods, with the assurance that the controller will regulate his descent, by means of the sprocket chains traveling on the sprocket wheels, connected with the mechanism, for regulating the rotation of the cylinders and the rotary pistons which are connected with the sprocket wheels.

Hardware.

LOCK.—W J Lambert North Yakima, and E P Dopps, Sunnyside, Wash One object in this invention is to provide a simple strong, and durable combination or permutation lock which is inexpensive to manufacture which can be easily operated, and which it is practically impossible to unlock without destroying the lock, unless the proper combination or permutation is known

WINDOW FASTENER.—W Agin Chillicothe, Ohio. The device comprises a casing bolts arranged at right angles to each other and movable through the casing, one being provided with an enlarged portion having a transverse recess, with an inclined inner edge the other having a cam within the recess and engaging the inclined face of the recess and a spring between the enlarged portion of the bolt and the casing wall and a latch pivoted to the enlarged portion of the end wall of the casing having a slot through which the latch passes, the latch having a catch for engaging the edge of the slot for retaining bolts in retracted position.

Heating and Lighting.

APPARATUS FOR WATERING COKE-OVENS.—D B Stauft Scottdale, Pa The invention is an improvement in appliances of the character disclosed in Letters Patent formerly granted to Mr Stauft, for watering coke-ovens, the present invention being particularly directed to improvements in the pivotal support of the revolving sprinkler-pipes, and has for a purpose to provide for the adjustment of the tubular pivot and prevent leakage thereabout,

METHOD FOR PREVENTING THE FORMATION OF BOILER-SCALE.—T Braida, Amstetten, Austria-Hungary The subject-matter of the invention is a method for preventing the formation of boiler scale, or for preventing the formation of incrustation on the walls of steam boilers and other receptacles under pressure The method differs from chemical and mechanical processes, or those known heretofore, as the feed water is introduced into the boiler without admixture of chemicals and in a definite form in which it prevents formation of scale.

Machines and Mechanical Devices.

EXPANSION CUTTER HEAD FOR BORING BARS.—Charles M. Buck, Huntington, W Va. The tool is particularly adapted for boring the hubs of car wheels, although it will be found serviceable in many other applications. It is in the form of a mandrel with a boring head in which adjustable cutters are seated. The cutters are separately adjusted so that one pair can be used as roughing cutters and the other as finishing cutters. An illustrated description of this tool appeared in the issue of June 19th, but the title contained a typographical error, making it read "Cutter Head for Boring Brass" instead of "Boring Bars."

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions, books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of March 18th or will be sent by mail on request.

(12107) A. K. says: 1. Is the direction of an electric current from positive to negative, or the reverse? A. The direction of an electric current is always taken to be from positive to negative. This is, however, entirely conventional. We could as easily do all electrical work and make all calculations on the theory that the current flows from minus to plus. It is simply by agreement that we consider that pole of a battery plus which is at the end of the carbon plate. 2 Are the two ends of an electrode of the same sign? A. One end of a plate in a battery cell is plus and the other minus. An electrode is the end of an electric circuit, and is of the opposite sign from the other end. The zinc in a cell is plus. The end of the circuit attached to the zinc is the minus electrode of that circuit 3, Does the current of electricity enter an X-ray tube at the anode or cathode? A. The current is considered to enter a Roentgen ray tube at the anode. The cathode rays stream from the cathode, and strike the anode, producing the rays from the anode 4, What is the effect of X rays upon the skin exposed to them for a time? A. The Roentgen rays are very injurious to one exposed for a long time to them, producing even death

(12108) P G F says Can you give me the scientific theory of what causes diamonds to form in the earth, and what kind of mineral do they form out of before they become a diamond? If you cannot give me any information on diamonds, please inform me where I can get the information. A. Carbon exists in three forms—charcoal, graphite, and diamond Heat and pressure are thought to be the forces necessary to change the substance from one to the other of the higher and harder forms. Some diamonds have been made artificially by placing carbon in powdered form in melted iron. The iron is then suddenly chilled and cooled, with the result that an enormous pressure is brought upon the carbon particles, and upon dissolving the iron away, tiny pieces of carbon are found as hard as a diamond. They are of microscopic size, but are of interest as possibly illustrating how diamonds have resulted under the great heat and tremendous pressure which have existed in the interior of the earth in remote times. The diamonds which are mined in South Africa are found in holes or pipes, which lead down through the rock strata into the interior of the earth, and it is suggested that they have been brought up from an unknown depth in the melted rock SUPPLEMENT No. 1571, price 10 cents, deals with the genesis of the diamond.

(12109) F J says: I note in your issue of May 15th, in reply to query 12084 you say that the number of contacts between the blades on disks *A* and *B* are the same whether one disk is stationary or whether they both revolve in opposite directions at ten thousand R P M. I beg to call your attention to the fact that you have not taken into consideration the distance traveled by the circumference of each disk; therefore if disk *A*, with ten blades, revolving at ten thousand R.P.M., comes in contact with one blade of stationary *B* one hundred thousand times in one minute, then if *B* is started revolving in the opposite direction at the same rate of speed, the number of contacts is exactly double, for the reason that each blade has only to move one-half the distance to make the contact when both disks are revolving This solution is taken from your diagram, which shows that the disks revolve in a direction so that they strike each other. If the disks revolve in such manner that they would mesh together like the cogs of a wheel, your solution would be correct, and there would be no difference as to whether one or both disks were revolving. A We thank you for your correction, which is certainly just. Our reasoning was based on the rotation of the wheels in opposite directions, as if they were intermeshing gears, and we overlooked the direction of the arrows on the inquirer's sketch.

(12110) C. N. T. says: As I understand it, the Thermos bottle is constructed on the principle that vibrations will not cross a vacuum. If this is correct, how does an incandescent electric light, with a carbon film in a vacuum, give off both light and heat? A. The Thermos bottle is constructed on the principle that heat waves of low radiant energy will not pass through a vacuum. Heat waves of high radiant energy, such as those from a fire or incandescent body, [illegible] the sun, will pass easily through a vacuum [illegible]

[illegible] of the Wright [illegible] actually fly [illegible] considerable [illegible] the craze which has [illegible] of toy aeroplanes, this little [illegible] will be found very timely [illegible]

TROUBLE FINDER CHART FOR AUTOMOBILISTS. By Roger B. Whitman, Technical Director of the New York School of Automobile Engineers. New York: Whitman & [illegible]. 50 cents.

This chart, which was originally published in the last Automobile Number of the SCIENTIFIC AMERICAN, is the most complete chart of the kind which has been brought out up to the present time. In publishing it printed in sections on separate cards, the author has made it available in a very handy form for all automobilists. There are about a dozen cards dealing with [illegible] make-and-break ignition; "jump-spark" ignition by battery and coil and by low-tension or high-tension magneto and coil; carburetor; compression; fuel-feed system, and [illegible] operation and maintenance. Two of the most useful cards give lubrication tables, showing how to oil every part of the car, while most of the other cards give a complete diagnosis of the troubles that may occur with the different organs, so that any novice can soon locate the trouble and make the necessary repair This chart will be welcomed by all automobilists.

MRS. RORER'S VEGETABLE COOKERY AND MEAT SUBSTITUTES. Philadelphia: Arnold & Co., 1909 12mo.; [illegible] pages. Price, $1.50 net.

Mrs. Rorer is regarded, and justly so, as being one of the greatest authorities in the world on the subject of cookery, and her views are perhaps more widely quoted than those of any one else in the culinary world. The great value of Mrs. Rorer's books is the extreme accuracy with which she pens her receipts. They seldom, if ever, fail if the directions are properly followed. There is no more acceptable book for the housekeeper than Mrs. Rorer's New Cook Book, which the present volume admirably supplements. It is very often said that we use too much meat in our American cuisine, and in fact "the American breakfast" is looked upon with horror abroad. It appears to be a fact that many persons can perform their work much better if they have no meat in the morning, and much of the hardest traveling in Europe is done with only the continental breakfast of rolls and coffee. Breakfast, however, with the aid of this book can occupy a middle ground between the sodden meat breakfast and the scanty French breakfast. Many of the meat substitutes are admirable. The receipts are very carefully arranged, and the book is well printed and bound. It is one which we can heartily commend to all our readers.

BOX FURNITURE; HOW TO MAKE A HUNDRED USEFUL ARTICLES FOR THE HOME. By Louis Brigham. New York The Century Company, 1909. 12mo.; 304 pages. Price, $1.60 net.

The author has produced a very remarkable work. It is very curious what can be done with a few old boxes. Here are some of the articles enumerated Plant box, golf-stick stand, kitchen stool, hanging lantern, coal box, blacking box, clock case, spice box, pipe rack, knick-knack brackets, housewife's handy rack, magazine racks, shoe cupboards, flower stands, wash stands, writing desks, book cases, [illegible] stands, office files, game tables, [illegible] stands, photographic [illegible] stands, [illegible] presses, chafing-dish table, [illegible] rack, wall rack, tea table, [illegible] wardrobe, sideboard, [illegible] closet, hall stand, etc. [illegible] are given. The [illegible] materials are stated. Then follows a detailed description of the [illegible]. We have not seen any book that [illegible] make things which [illegible] in a [illegible] not only describes [illegible] of furniture [illegible] [illegible]

WIRELESS TELEGRAPHY [illegible]

[illegible] about an [illegible] plane [illegible] of the triangles A and B (Fig. [illegible]) [illegible] be made to coincide by any movements in their own plane, but by rotating one of them 180 deg. in the third dimension it can be made to coincide with the other. Similarly, two symmetrical volumes (with faces equal but in reversed order) such as the hollow pyramids C and D (Fig. 4) cannot be made to coincide by any movements in our space, but by rotating one of them 180 deg. in hyperspace this can be done. The rotating pyramid disappears from our space, and upon its return after rotating 180 deg. it can be slipped into the other. In our space two movements of rotation will combine into a single resultant rotation, similar to its component rotations except that the direction of the axis is different. In hyperspace however, there is in general no resultant for two rotations. Hence there are two different types of rotation in hyperspace and a body subject to two rotations is in a totally different condition from that which it is in when subject to one only. When subject to one rotation a whole plane of the body is stationary. When subject to the double rotation no part of the body is stationary except the point containing the two planes of rotation and if the two rotations are equal every point in the body except that one describes a circle.

Freedom of movement is greater in hyperspace than in our space. The degrees of freedom of a rigid body in our space are 6 namely 3 translations along and 3 rotations about 3 axes while the fixing of 3 of its points can prevent all movement. In hyperspace however with 3 of its points fixed it could still rotate about the plane passing through those points. A rigid body has 10 possible different movements in hyperspace namely 4 translations along 4 axes and 6 rotations about 6 planes while at least 4 of its points must be fixed to prevent all movement. A material point in our space can be prevented from moving by connecting it rigidly with three fixed points outside in hyperspace it must be rigidly connected with at least 4 points outside.

In hyperspace a sphere if flexible could without stretching or tearing be turned inside out. Two rings of a chain could be separated without breakage. Our knots would be useless. Thus the knot shown in Fig 5 could be unknotted without removing the fastened ends. Just as in our space a point can pass in and out of a circle without touching its circumference, so in hyperspace a body could pass in and out of a sphere (or other inclosed space) without going through the surface surrounding it. In short, all of our space including the interior of the densest solids is open to inspection and manipulation from the fourth dimension, which extends in an unimaginable direction from every point of space.

Has hyperspace a real physical existence? If so, our universe must have a small thickness in the fourth dimension otherwise like the geometrical plane assumed to be without thickness our world too would be a mere abstraction (as in fact some idealistic philosophers have maintained), that is nothing but "a shadow cast by a more real four-dimensional world." The real existence of a [illegible] in the fourth dimension [illegible] simplify certain scientific [illegible] For instance, in our space [illegible] points whose [illegible] space would explain the change of a body producing a right-handed into one producing a left handed polarization of light. Further Prof McKendrick said before the British Association "It is conceivable that life may be the transmission to dead matter [illegible] of a form of motion *sui generis*." Hyperspace has been brought somewhat in disrepute because spiritualists have assumed its existence in order to give a local habitation to their vagaries. Nevertheless the possibility of its existence has not yet been shown to be inconsistent with any scientific fact and the limitation of space to three dimensions though probably correct is therefore purely empirical.

Of what use then is the conception of hyperspace? For one thing it gives a deeper insight into geometry. Thus a circle considered merely as a one dimensional aggregate of points has very few properties while in a plane it has a center radii tangents etc and in 3 space has further numerous geometrical relations with the sphere cone etc. Similarly the properties of any given line or surface increase in number when investigated in hyperspace. Also just as it requires a 3-space to include certain one dimensional aggregates (the helix for instance) so in hyperspace hitherto unknown lines and surfaces become mathematically possible. Lower spaces are contained in higher (if curved not necessarily the next higher) and just as the comprehension of plane geometry is enlarged by viewing plane figures in 3 space so solid geometry is much illuminated by the geometry of hyperspace. Fields of mathematics hitherto inaccessible to geometry are now elucidated by geometrical representations. Finally this conception effects a complete divorce between geometric space and real space no longer considered necessarily identical and in other ways also enlarges our mental horizon.

◆

A MUSEUM TO ILLUSTRATE THE DEVELOPMENT OF MATHEMATICS

(Continued from page 10.)

two astrolabes of Italian make and dating back to the fifteenth and sixteenth centuries are illustrated so that it is possible to appreciate their fine workmanship and the accuracy of the division of the circular scales. Then at this time there were various forms of celestial spheres planispheres or armillary spheres where a number of concentric circles were used to illustrate the motion of earth and planets in the celestial sphere a sixteenth century example of which of Italian workmanship is shown herewith the principal circles of the heavens are represented as well as the polar axis located within meridian and horizon circles at the center of which the observer is supposed to be. With such armillary spheres of which the collection contains a number of specimens the motions of planets and earth could be shown and also direct measurements could be made. Not only are there Italian and German instruments of this kind dating back to the fifteenth and sixteenth centuries and used by such astronomers of that time as Tycho Brahe but there are similar instruments from India Persia and Arabia one of which in modern times was used by Pandit Joshti in the restoration of the ancient observatory of Jaipur India. The similarity of the instruments of Europe and Asia is very striking and interest is heightened by the exhibition with the latter of Hindu and Persian texts explaining their use. Indeed the correspondence between the methods and instruments of peoples remote from one another as brought out in the exhibition is often most impressive and a comparison of a Japanese sphere of the sixteenth and seventeenth centuries with European spheres of the same period shows many points of identity.

Not a few Japanese instruments and manuscripts are included in the collection as for example the surveying com

(Continued on page 31.)

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INDEX OF INVENTIONS

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June 22, 1909,

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

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Adjustable bit, J. H. Paulus 925 500
Adjusting device, J. P. Boyden 925 448
Aerial flight chute, A. Feller 925 764
Agricultural implement, A. C. [illegible] 925 926
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Box, toe powder, W. H. [illegible] 925 148
Brake shoe, C. D. Pettis 925 [illegible]
Brewing, M. Henius 925 701
Brick and block mold, O. W. Jones 925 [illegible]
Bridge, O. Thomas 926 [illegible]
Broom corn, machine for removing [illegible] from, W. H. Van Sickler, Jr. 925 61
Brush, expanding, Heyward & Klat[illegible] 925 [illegible]
Bucket, garbage, H. W. Schmidt [illegible] 51
Building and shelving construction, E. R. Reicher 925 977
Building, sanitary, H. Keltsch[illegible] 926 [illegible]
Burial casket and vault therefor, [illegible] J. Coput 925 835
Butter cutting machine, E. R. Wells 925 842
Cable chain grip systems, switch for automatic, G. H. Fouts 926 084
Caloric engine, L. G. Woolley 925 97
Can attachment, oil, F. [illegible] 925 870
Can body forming and soldering machine, J. Eldridge 925 [illegible]
Can opener, J. Castlaky 926 051
Canister, non-refillable, N. J. Harrington 925 [illegible]
Car brake, J. W. Lamoreaux 925 [illegible]
Car brake operating mechanism, H. Dixon 925 [illegible]
Car conveyer, J. B. [illegible] 925 [illegible]
Car coupling, M. West[illegible] 925 [illegible]
Car [illegible] carry iron, C. A. Humphrys 925 [illegible]
Car derailing device, [illegible] 925 [illegible]
Car door [illegible] freight, J. W. Tolman 925 [illegible]
Car dumping, [illegible] Axtrom 925 [illegible]
Car emergency brake, street, J. Hauser 925 [illegible]
Car, passenger, C. E. Pirtle 925 [illegible]
Car stake, E. J. Evans 925 [illegible]
Car step raising device, W. W. Brown 925 [illegible]
Car [illegible], E. E. Davies 925 [illegible]
Car underframe, H. M. Pflager 925 [illegible]
Carbureter, Winton & Anderson 925 [illegible]
Carbureter, R. E. Warren 925 [illegible]
Card holder, W. F. Clay 925 [illegible]
Carton or package, W. F. Fell 925 [illegible]
Cash register, C. Osborn 925 [illegible]
Caskets or burial vaults, making, A. E. Magowan 925 [illegible]
Casting metal structures in permanent molds having permanent cores, B. A. Carter 925 [illegible]
Centrifugal machine, speed indicator for, L. A. Lehmann 925 [illegible]
Chain links, making, J. M. Dodge 925 [illegible]
Chain making, T. F. Scher 925 [illegible]

(Continued from page 15)

passes shown in the accompanying illustration. While these particular instruments are comparatively modern, being of the early nineteenth century, yet they antedate the general introduction of western ideas into Japan, so that their makers doubtless derived their inspiration from either Jesuit or Dutch East India Company influences. The manuscript shown in the background is one of a number of Japanese treatises on surveying belonging to Prof. Smith, in which the diagrams, often in color, are most artistically executed.

Returning from the East, our interest is attracted by a small wooden cylinder with vertical slits, which was used by the early Italian surveyors. It is known as a *squadra*, and could be mounted on a staff, where, by sighting through its slits arranged at angles of 90 deg. and such other convenient angles as might be needed, it was possible to run the boundary lines of land. A common level used in the same fashion as the more modern gunner's quadrant, and placed on the breech of a cannon to determine the elevation, is a small but excellent piece of Italian make, while a German level of the eighteenth century suggests rather more closely modern surveying instruments. This tendency is even more evident in the German surveying instrument of the early nineteenth century, which, lacking the telescope and compass, has almost every essential feature of the modern transit or universal instrument, being designed for the measurement of both horizontal and vertical angles, and showing fine workmanship and accurate division of the circles.

The mathematician is always interested in weights and scales, for aside from the arrangement of various forms of weighing devices, the division of the weights themselves and the relation of the standards and units present many problems. Thus there are many scales and balances which show the various applications and modifications of the lever, and especially in the case of those belonging to primitive people they are valuable in bringing out the development in the art of weighing. The European weights, two nests of which are shown in the photograph with the Bavarian spring balance, were often of beautiful workmanship, and the subdivision was carried out with an accuracy that is most surprising.

The measure of time also finds an important place in the museum, for the calculation of the calendar in all religions was one of chief occupations of mathematicians, but especially in the early Christian church for the computation of Easter. The Buddhist temples of Japan were concerned with calendars quite as much as the Western Church, and their calendar rolls of the sixteenth and seventeenth centuries and other appurtenances show the attention paid to the subject on this side of the world. Accompanying the instruments themselves in most cases throughout the museum are to be found the contemporary authorities in book or manuscript, and while three of the earliest publications on the reform of the calendar by Pope Gregory supply first hand information to the student in this field, there are also Chinese, Japanese, Hindu, Church Latin, and other manuscripts in addition to works in the tongues of mediæval and modern Europe for the investigator with such languages at his command. Prof. Smith has collected from East and West representatives of all the important forms of portable sun dials, many of which exhibit artistic merit in their design and construction besides considerable complexity in their arrangement. An interesting sun-dial from Peking is shown in the illustration, where, with its divided circles marked with Japanese characters, its compass and other features, a number of points of interest are presented.

In a museum of mathematics there are of course to be found in plenty compasses, sectors, protractors, diagonal scales and

(Continued on page 17)

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Chuck, [illegible]	[illegible]
Chuck, [illegible]	[illegible]
Churn dasher, J. H. Moller	[illegible]
Chute, coal, B. M. [illegible]	[illegible]
Cigar bunch molds and removing the bunches therein, apparatus for opening, J. H. Schmitt	[illegible]
Circuit breaking device, E. L. Rancourt	[illegible]
Circuit wire connection shield, T. H. Murray	[illegible]
Clamp, Hunning & de Lange	[illegible]
Clamp, H. R. [illegible]	[illegible]
Clamp, Horton & Jourdan	[illegible]
Clamp and stabilizer combined, O. Stout	[illegible]
Cleaner. See [illegible] cleaner	
Clothes hanger, H. C. Stanley	[illegible]
Clothing case, J. A. Cunningham	[illegible]
Clutch, W. Dennis	[illegible]
Clutch, J. A. Sharp	[illegible]
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Conduit holder, Dillon & Welsh	[illegible]
Contact [illegible] multiple, H. H. Lincoln	[illegible]
Controller, A. W. Cheney	[illegible]
Convertible chair, H. A. Britton	[illegible]
Conveyer, A. A. [illegible]	[illegible]
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Cooking apparatus, H. A. Winterknight	[illegible]
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Corking apparatus, bottle, C. [illegible]	[illegible]
Corn husking hook, R. N. Thomas	[illegible]
[illegible] piece, A. J. Schornecke	[illegible]
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Cotton chopper, A. D. Bell	[illegible]
Cotton chopper, B. C. Gesche	[illegible]
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Curtain fixture, P. [illegible]	[illegible]
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Drawing instrument, spiral and circle, W. Brierley	[illegible]
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Electric cables, fault locator for, Pennell & Hoffman	[illegible]
Electric current regulator, H. A. Kelp	[illegible]
Electric kiln, Harper & Larkworthy	[illegible]
Electric machine, alternating current dynamo, W. Stanley	[illegible]
Electric machine, alternating current dynamo, B. [illegible]	[illegible]
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Elevator door guard, L. Christiansen	[illegible]
Elevator door opening attachment, A. B. Karg	[illegible]
End gate, C. S. Wright	[illegible]
Engine. See Caloric engine	
Engines, apparatus for producing uniform fluid pressure for, B. [illegible]	[illegible]
Entrail cleaning machine, L. Svoboda	[illegible]
Envelop, M. J. Shaffer	[illegible]
Envelop and seal tag, J. H. Reeves, Jr	[illegible]
Envelop pack, O. C. Sweet	[illegible]
Equalizer, W. H. [illegible]	[illegible]
Eraser cleaner, blackboard, A. [illegible]	[illegible]
Excavating and ditching device, W. Webster	[illegible]
Excavating bucket, W. C. Mitchell	[illegible]
Fabrics, joining or connecting, W. Keller	[illegible]
Fabrics to render them adhesive, treating, F. J. Oleson	[illegible]
Fastening device, E. A. [illegible]	[illegible]
Faucet, quick closing, H. F. Schroeder	[illegible]
Feed bag supporter, [illegible], E. J. Colgan	[illegible]
Felloe making wheel, M. Conrad	[illegible]
Felly for wheels with pneumatic tires, T. Brickner	[illegible]
Fence builder, wire, W. S. [illegible]	[illegible]
Filter leaf, Blaisdell & Brooks	[illegible]
Filter or strainer, I. J. True	[illegible]
Filtering machine, E. T. [illegible]	[illegible]
Fire alarm, automatic, [illegible]	[illegible]
[illegible], Knapke & Lange	[illegible]
Fire plug, J. W. Smith	[illegible]
Fish trap, J. H. Wilson	[illegible]
Flexible coupling, Thompson & [illegible]	[illegible]
Fluid pressure brake, W. F. A. Macfarlane	[illegible]
Fluid pressure regulator, F. L. John	[illegible]
Fly catcher, W. [illegible]	[illegible]
Fodder tie, W. A. [illegible]	[illegible]
Freezing apparatus for concentrating solutions by, H. Monti	[illegible]
Frog, D. Salomone	[illegible]
Fruit assorting or sizing apparatus, H. K. Rowland	[illegible]
Fruit gatherer, J. W. Fahnestock	[illegible]
Funnel, automatic self-closing, [illegible] & [illegible]	[illegible]
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(Continued from page [illegible])

[illegible] which, extending from Roman to Renaissance and later times, indicate very clearly the developments in this field, while the specimens of measures of length shown suggest most forcefully the chaotic conditions that but little more than a century ago prevailed in metrology when every nation and almost every town had its individual and peculiar standards quite unlike the others except in having the same names. One of the measures well illustrating this condition is a brass Austrian ell standard of 1782, while the various gagers' scales show the debts that metrology and mensuration owe to the collection of excise taxes.

From the slates and possible abaci of the neolithic age in Egypt to the modern counting arithmometer of the accountant or professional calculator certainly is a far cry, but the steps are marked and are shown in this collection. In the beginning is a squeeze or impression from the Salamis abacus, the earliest one known; then the Chinese swan pan, the Japanese soroban, the Korean bones, the old Japanese sangi, the Russian stchoti, the Armenian abacus and other similar forms, many of which still in use suggest the familiar frame and beads of the primary school. But by such schemes, slide rules and more involved devices, artificial calculation has progressed to its present state.

The many readers of the SCIENTIFIC AMERICAN interested in magic squares perhaps will be surprised to learn that in the Yih King, one of the greatest Chinese classics, here shown in written manuscript on silk, is found the first trace of the magic squares attributed to Fuh Hi (B. C. 3322), the traditional founder of the nation, as well as of permutations and possibly of binary numerals. Indeed number mysticism as shown in the magic squares and like phenomena turns up in many interesting forms and places, as is shown here by plaster casts of inscriptions from Chittagong, India, and in more modern times in a reproduction of Dürer's Melancholia, where is exhibited the oldest magic square known to exist in print. The magic squares by inscriptions and manuscripts may be traced in astrology, while some interesting Pali and Singhalese manuscripts on palm leaves show forms of its expression in India.

A collection of dice would seem hardly in place in an educational museum, but as the historical development of this game, which is one of the oldest if not the oldest of the many number games, can be traced over at least 3,000 years, it lends itself readily to exposition. And it is important further in that its influence in educating people in the use of numbers has been second only to the school. In Prof. Smith's collection we can view dice from Etruscan tombs, from the remains of the Persian invaders from Karnak in Egypt, a divination eikosahedral piece of the Ptolemaic period, long dice of the Roman conquerors of lower Egypt, loaded dice of Rome, dice of Renaissance Europe, and so on to our own times.

The many medals of famous mathematicians here shown of themselves make a unique exhibition, with Newton honored by twelve different medals and others hardly less famous in proportion, and these with the original manuscripts, autographs, and portraits bring to the study of their works much that is personal. And we find the mathematicians of the East represented with those of the West, there being such documents as manuscripts of the work of Bhaskara, the greatest of native Hindu mathematicians, who flourished in the twelfth century, and whose work was influential both in India and the adjacent countries of Ceylon and Persia. There are facsimiles of the Ahmes and [illegible] Egyptian papyri, the former of which is the oldest manuscript extant, and [illegible] from about 1700 B. C. [illegible] a treatise of about [illegible] of ideas and [illegible] mathematical science from [illegible] only to be brought [illegible]

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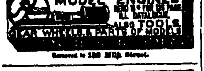

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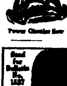

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(Concluded from page 17)

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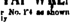

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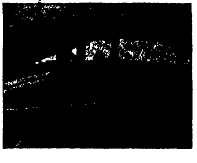

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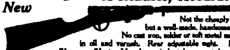

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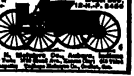

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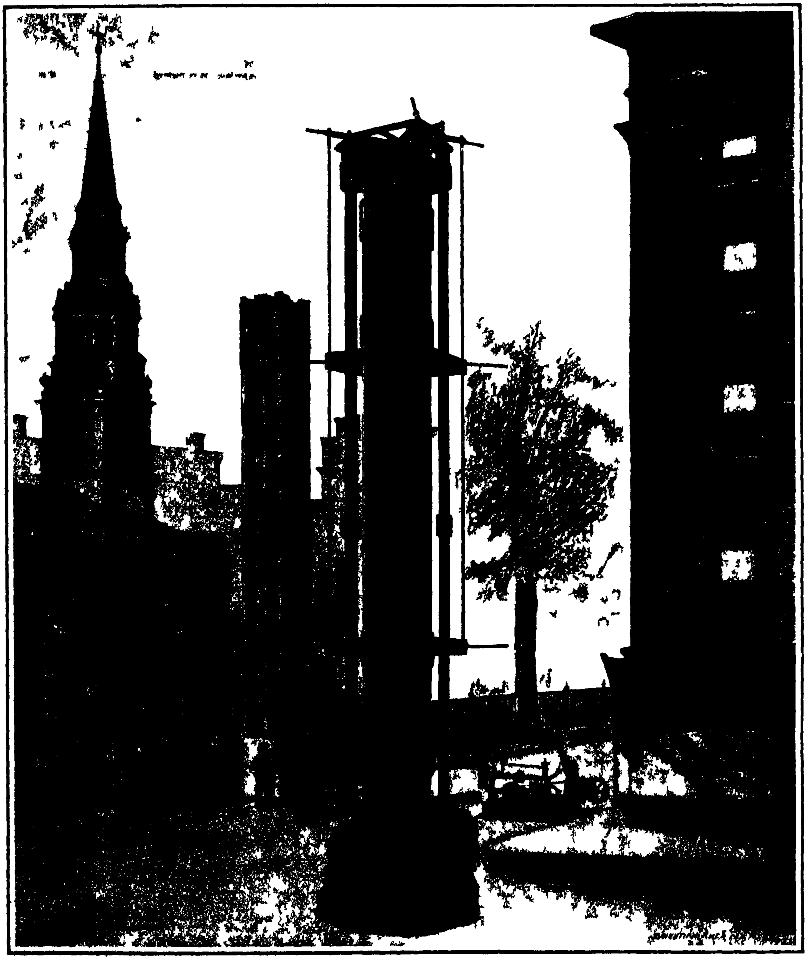

This machine, 80 feet high and capable of exerting a crushing pressure of 5,000 tons, is being built for the testing [illegible] United States Geological Survey. It will be used to test the breaking strength of stone, brick and concrete and of large steel columns for bridges and buildings. The two members shown are chord sections of the Quebec and Queensboro bridges.

GIANT TESTING MACHINE FOR DETERMINING THE STRENGTH OF STEEL COLUMNS.—[See page 26.]

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NEW YORK SATURDAY JULY 10th, 1909

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the *facts authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates

THE ELECTRIC LOCOMOTIVE OF THE FUTURE

The announcement has recently been made that the New Haven Railroad Company is about to extend its electric zone from Stamford to New Haven a distance of over forty miles It is understood that in all its essential features the same system will be employed as that which has now for nearly two years been in successful operation from Stamford to New York, and the announcement is taken to indicate that the bold experiment which the New Haven Company made in equipping its four track trunk line with an alternating current plant and overhead conductors transmitting current at 11 000 volts directly to the locomotives has proved to be thoroughly successful This important extension of the electric zone is particularly significant in view of the fact that contemporaneously with the change of power on the New Haven system the New York Central Road which uses the same terminal station at 42nd Street New York, equipped its own four track road with a direct-current system using 650-volt direct current and that the two roads have been operated side by side under practically identical conditions

Under each system alternating current of high tension is generated at a central power station On the New York Central line it is stepped down and converted into direct current in sub-stations On the New Haven road the transformers are carried upon the locomotives themselves, each of which therefore may be said to act as its own sub-station In the latter case there is the disadvantage that there is a great increase of weight in proportion to the power delivered to the axles This is shown by the fact that, whereas the New York Central locomotives can develop 2,200 horse-power for a weight of 102 tons the New Haven locomotives can develop only 1 000 horse power on 107 tons Consequently, it is necessary to employ two locomotives to make schedule express time with a New Haven express train of from eight to fourteen cars whereas a single New York Central locomotive can haul the same, and indeed an even larger number of cars and maintain the schedule

Because of the fact that the New York Central Company has not as yet extended its electric zone beyond High Bridge which is about seven miles from the 42nd Street terminal no opportunity has been afforded to test the behavior of the locomotives in hauling heavy trains over long distances, and the question has been raised as to whether they will be able to stand up to this service with the same regularity as has been shown by the New Haven locomotives, which have been regularly making the run of 35 miles to Stamford without developing any trouble in the way of overheating of the motors, etc.

Up to the present time neither company has shown any disposition to make public the details of the cost of operation Both have declared that in point of convenience and regularity of service the electric has shown a decided superiority over the steam service and it is conceivable that these advantages are such as to more than offset any increased cost due to the heavy initial outlay It is certainly significant that although the mechanical, electrical and indeed all the physical elements of the installations have been made public with surprising candor, absolutely no definite statement has been given out as to economy of operation It is to be hoped that, in the interests of electrical science and for the furtherance of this most important question of the electrification of steam railroads, the two companies concerned will consent at an early date to publish this eagerly awaited information.

DRYDOCKS FOR OUR BIGGEST BATTLESHIPS.

In raising the displacement of its battleships to 26,000 tons, the United States government has produced a ship which far exceeds the largest contemporary battleships built or building of any foreign navy, not even excluding Great Britain If the new vessels are constructed with a rapidity equal to that of the foreign navies, our navy will possess in the 'Wyoming" and her sister, at the time of their completion, the largest and most powerful battleships afloat.

This extraordinary increase in size brings with it some serious responsibilities, prominent among which is that of the provision of drydocks capable of accommodating these monster vessels, not merely when they are loaded to their full displacement but when, as the result of the terrific wounds which even a victorious 'Dreadnought" of the future is bound to receive the vessel may have sunk some six or seven feet below her maximum draft

The foreign governments, notably Great Britain and Germany are fully alive to the importance of this question Great Britain possesses on her eastern and southern coast eight drydocks which are available for ships of the Dreadnought' class, and four are in course of construction this estimate including both government docks and those owned by private shipyards. On the west coast there are six docks, making eighteen in all, whose depth and entrance width are sufficient to accommodate the largest battleships Germany has under construction or already completed twelve docks of the requisite capacity

In considering our own docking facilities it will be well first of all to state the dimensions of the 26 000-ton 'Wyoming" Her beam will be 93 feet 2½ inches, her draft on full load displacement slightly less than 30 feet and the length 566 feet. At the present time the depth of water over the sills of our largest dry docks would be sufficient to float the 'Wyoming' over the sill on her full load displacement only at high water and even then with but a slight margin to spare The navy yard docks that could accommodate her and their depth of water over sills are Portsmouth, 30 feet, Boston, 30 feet 7½ inches, New York, 33 feet 6 inches League Island Pa. 30 feet Charlestown, 34 feet, Mare Island 30 feet, Puget Sound, 30 feet, and the new Pearl Island dock, 35 feet depth at Hawaii To these must be added two private docks, one at Newport News and another at San Francisco, each with a depth of 30 feet The rest of the naval drydocks, seven in all, are either too narrow or shallow to admit the 'Wyoming" at full load draft The new docks which are now under construction or have lately been completed were originally designed to take a battleship of any size, but the dimensions of our ships have increased so rapidly that it becomes an interesting question as to what clearances of breadth and depth these docks would offer, if any, in docking the "Wyoming"

We understand that the Bureau of Yards and Docks has been endeavoring to keep pace with the work of the Bureau of Construction and Repair and that designs have been modified as far as possible to meet the new conditions The most important consideration is that of depth, since the injuries which a warship must suffer in an engagement will in all probability involve a certain amount of perforation of the hull and starting of seams, at or near the waterline, and the entrance of more or less water, involving a proportionate increase in the draft of the ship In a discussion of this subject, as affecting the British navy, our contemporary, Engineering, estimates that if the boiler rooms of one of the British "Dreadnoughts" of 20 000 tons displacement were flooded, her displacement would be increased about 2,500 tons and about five feet would be added to her draft, and if the engine room and side compartments were also flooded the draft would be increased seven feet above the original draft of 26 feet It is conceded to be possible that even the wings might be also flooded in addition to the engine and boiler rooms and the ship still remain afloat, in which case the displacement would be increased from 20,000 to 32,000 tons and the draft from 26 to 33 feet.

Now at her mean draft our own "Florida" draws 28½ feet, and at full load displacement about 30 feet. It is conceivable that at the close of a fierce engagement with a "Dreadnought" of her own power, whose guns were served by such well-trained crews as are found in the navies of one or two of the leading naval powers, the "Florida," even if victorious, might get back into harbor drawing 35 or 36 feet of water In this condition she would be barred from every one of the drydocks which we at present possess, and before she could be docked temporary cofferdams would have to be built and a part of the water pumped out.

It may be said in answer to this that it is useless to give to a drydock a greater depth than that of the entrance channels to the harbor or port in which it is located. The point would be well taken, if it were certain that the existing channel depths would be the depths for all time. As a matter of fact, the entrance channels of all of the important harbors of this country are certain to be continually deepened in response to the demands of navigation. The entrance channel to New York has been deepened from 32 to 40 feet; and in the construction of drydocks, whether for government or private yards, a due regard for the future should lead to the construction of all first-class drydocks with depths over sills and widths at entrances greater than the needs of the hour would seem to call for At the same time it is only just to the Bureau of Yards and Docks to state that our present drydock accommodations are fairly comparable with those of the other leading powers.

THE RAILWAYS OF THE WORLD.

America still continues, by a wide margin, to lead the world in the extent of its railway system. Out of a total of 594,867 miles of railroad in the whole world, 268,058 miles are located in North America. This is but little less than the total for the three continents of Europe, Asia, and Africa, Europe having 199,385 miles, Asia 56,294 miles, and Africa 18,519 miles, a total of 274,198 miles for the Old World. South America has a total of 34,911 miles, and Australasia of 17,700 miles of railroad, which added to the figures for North America, make a grand total for the New World of 320,669 miles.

The above figures form part of a report compiled by the Prussian Ministry of Public Works, for the year 1907, which shows that, compared with the previous year, the largest percentage of increase is that of 998 miles or 5 7 per cent in Africa, followed by 7,637 miles, an increase of 3 per cent, in North America, and 2,917 miles, representing an increase of 1½ per cent in Europe The greatest amount of construction in European countries was that in Russia, where 1 625 miles of new track were built, France was next with 431 miles and Germany built 411 miles. The largest additions in Asia were made in British India, where 909 miles were built, China coming next with 464 miles In South Africa, the largest addition was in British South Africa, where the mileage was increased 5¼ per cent by the addition of 352 miles.

During the decade from 1897 to 1907, there was extraordinary activity in the building of railroads throughout the world, 140,127 miles of new railroad being built in that time representing an increase of 23½ per cent The largest gain was in North America. The statistics of 85 per cent of the railroads owning the total mileage given above show that there is a total capital invested of nearly $42,000,000,000 If the same rate of cost has obtained in the railroads of which statistics were not available, the total outlay on railroads, from their inception to the present time, must be nearly $50,000,000,000 This would represent an investment of about $31.50 for each inhabitant of the globe at the present time.

THE DIRECTIVE SENSE OF BEES.

The directive sense which is possessed by bees is the object of researches made by M. Gaston Bonnier, of Paris, and he seems to prove that bees possess a special sense like that of carrier pigeons. Bees can fly for two miles from the hive and are then able to return after gathering their supply of honey Langstroth and others suppose that vision comes into play and that bees can see for a great distance and can also note objects on the way so as to find their path. Others, with Dadant, suppose that the bees are guided by the sense of smell, and that they can smell flowers at distances of 1½ miles. The author makes experiments to prove that bees can return to the hive without using either sight or odor As to sight, he takes bees to a distance of 1 2 miles from the hive, in a closed box. They always fly back to the hive when released The same is true when their eyes are covered, so that sight is not essential As regards odor, experiments seem to prove that bees perceive odors at only short distances. When a needle dipped in ether is brought near the head of the bee, it shows signs of perceiving the odor, but not so when the needle is placed back of him or near other organs. Besides, when the organs of smell (antennæ) are removed entirely, the bees will return to the hive. M Bonnier makes the following experiment: At 600 feet from the hive he places a supply of syrup, and the bees soon find it, proceeding to and fro to the hive. Such bees he marks with green-colored powder. He then places a second supply of syrup at the same distance from the hive, but spaced at 30 feet from the former. Other bees are now engaged in the to and fro movement to this point, but these are not the same individuals as the green marked ones, who are still working on the first supply, and he marks these by red. We thus have two distinct sets of bees, and we see that they can distinguish two directions which form a very acute angle. We seem to have here a special directive sense which does not reside in the antennæ, but probably in the cerebral ganglia. Other facts may be cited in evidence of the directive sense of bees.

ENGINEERING.

The important work of deepening the channel to the city of Baltimore has been so far completed, that there is a depth from the city to the sea, if we except the crossing of York's Spit at the mouth of Chesapeake Bay, of 35 feet, and a channel width of 600 feet. Opposite Fort McHenry the channel is to be widened out to provide an anchorage for ocean-going vessels.

The increasing precipitation of the rainy season is having its usual effect of reducing the amount of excavation on the Panama Canal The rainfall in April was 4.36 inches, in May it was 9.82 inches and the excavation fell from 3,454,649 cubic yards in the former to 2,896,095 cubic yards in the latter month There is an increase, however, in the total amount of concrete laid, which was 11,586 cubic yards in May as against 7,978 cubic yards in April

The average speed for the transatlantic passage is now within 0 12 knot of the 26-knot mark On June 21st, the "Mauretania" on her passage to the eastward passed Brow Head at 8 A. M., having made the passage from the Ambrose lightship, Sandy Hook, in 4 days, 17 hours, and 21 minutes The successive day s runs were 588, 606, 609, 608, and 524 miles. The total distance is 2,937 knots, and it was covered at an average hourly speed of 25 88 knots.

The new United States ships of the 'Dreadnought' type, among other novelties of construction will embody three electric passenger elevators. They will have a lift of a little over twenty feet, and they will be used mainly by the watch officers whose duty takes them from fireroom to fireroom The elevators are rendered necessary by the fact that there are no doors between firerooms on the new ships The first elevator to be used in the United States navy was installed on the hospital ship 'Solace" during the Spanish war

The worldwide falling off in business in 1908 made itself felt in the traffic through the Suez Canal During 1908 there passed through the canal 3,795 vessels of 13,633,283 tons net, a decrease of 472 vessels and 1,095,151 tons as compared with 1907 There was an increase in the size of the individual type of vessels, and the average time of passage, seventeen hours and twenty-four minutes, was the best that had been made in any year since the canal was opened

It is understood that a majority both of the Canadian and American Commissioners of the International Waterways Commission will recommend that a dam be built on the Niagara River, opposite Buffalo and Fort Erie, for the purpose of raising the level of Lake Erie. In the autumn of every year there is a fall of about two feet in the level of the lake This reduction of available navigation depth seriously affects the shipping interests, and with the increase in the size of vessels it is becoming a menace to navigation. The estimated cost of the dam is about $5,000,000

The growth in size of steamships and in the cost of labor and the materials of their construction has caused a great increase in the total cost of transatlantic steamships during the past decade Thus the 'Kaiser Wilhelm der Grosse," 1897, cost a little over $2,500 000, the "Oceanic," 1899, $3,000,000, the "Deutschland," 1900, $3,250 000, and the "Kaiser Wilhelm II." 1903, $4 000,000, while the estimated cost of the "Mauretania" is $6,750,000 The most fruitful cause of the increase in cost has been the effort in each ship to outdistance her predecessor in speed This has led to an increase in the engine power from 30,000 in the "Kaiser Wilhelm der Grosse" to 70,000 in the 'Mauretania."

An engineer who has recently made a tour of the waterways of the Middle West, to gather data relative to proposed waterway improvements, informs us that he was astonished to find what a large amount of freighting is done by individual storekeepers and smaller merchants in launches propelled by internal-combustion motors. The country storekeeper, living on the banks of rivers and canals, has found that he can ship his own freight from the wholesale dealer and distribute it to his retail customers by motor boat, at a cost far below that of any other available means of conveyance. There is in this fact a suggestion of future usefulness for abandoned canals in which the draft is limited.

Frequenters of the classic Battery Park at the southern end of Manhattan Island were forcibly reminded of the palmy days of "America" cup racing, when they saw a gang of Park Department riggers hoisting into position a new flagpole, which turned out to be nothing more nor less than the mast of the old cup defender "Constitution." The lower mast is built of steel and is, of course, hollow. Telescoping into this is the wooden topmast. The foot of the mast is bolted to a block of concrete, and the truck of the topmast from which the flag flies is about 165 feet above the sea wall. In the rigging of the mast Herreshoff tried a new system of double crosstrees. Breakages of the spars were frequent, and he subsequently, in the "Reliance," returned to the old system of single crosstrees.

ELECTRICITY.

A novel grounding device is now in the market, which is made up of a number of double convex disks secured to a central rod of a conductive material The disks are non-metallic, but are formed of absorbent material which retains moisture The advantage of this grounding device is that it is not affected by acids or alkalis, so that it provides a permanent ground connection of high capacity When the device is placed in the ground a pailful of strong brine is poured over it and as the earth is filled in over the disks, more salt water is added so as to increase the conductivity of the surrounding earth

The recent agitation in the Southern States in favor of electric headlights on locomotives has led to the design of several very efficient turbo-generator sets of such design that they can be placed directly on the locomotive boiler and be driven by steam taken from the boiler A very compact outfit of this type was exhibited at the recent Master Car Builders and Master Mechanics' conventions in Atlantic City The turbine is of the impulse type, consisting of a single wheel, provided with re-entrant paths for the steam which receives nearly its total expansion at the nozzles. One model shown was directly connected to the headlight It supplied a current of 25 amperes at a tension of 30 volts.

A miner standing at the bottom of a shaft 2 500 feet below the surface of the ground in the Clear Creek district, Idaho, can carry on a telephonic conversation with Chicago, says the Electrical Review and Western Electrician However only a miner can telephone in such surroundings owing to the noise of the drills and other machinery in operation all about. The telephone instruments used in the mine are of special construction to protect them from dampness There is a regular telephone system connecting over one hundred mines in the Idaho Springs district all of which mines are tapped by an underground railway through which the telephone wires run

The first electric locomotive for the Detroit River tunnel has been completed This locomotive has a weight of 199 000 pounds It is of the articulated type It is provided with four motors each adapted to develop a tractive effort of 9 000 pounds at 12 miles per hour The maximum speed of the locomotive is 35 miles per hour It is provided with the multiple-unit type of control, the motors being so arranged that they may be operated four in series, four in parallel or two in series and two in parallel The system of control makes it possible to start a train so gradually that the motion is almost imperceptible This locomotive is one of six which have been ordered for the tunnel, and is designed for use in hauling both passenger and freight trains

As a substitute for large condensers using paper, glass, or mica for the dielectric, an electrolytic condenser has been devised which consists of aluminium electrodes immersed preferably in ammonium borate. Magnesium or tantalum electrodes can be used but aluminium is preferred because it is cheaper The current acting upon the metal causes it to be coated with a thin layer of oxide but this oxide is very porous, and in the pores a gas is formed which serves as a dielectric between the metal and the electrolyte. The resistance of this gaseous dielectric increases with the tension up to a certain critical point Experiments have been made with various electrolytes and it was found that the critical tension with sulphate of soda was 40 volts, permanganate of potassium 112 volts, bichromate of potassium 122 volts silicate of soda 415 volts, citrate of ammonia 470 volts borate of soda 480 volts, and citric acid 535 volts. The best effect was that of ammonium borate with a critical tension of 403 volts. There was quite a loss of current with tensions above 90 volts

One of the principal problems considered by the International Meteorological Conference in London last week was the question of wireless marine weather reports. Prof Willis L. Moore, representing the United States, urged the necessity of adopting regulations that will compel a ship beyond a certain tonnage to carry wireless instruments and operators and to take at noon Greenwich time a daily observation of the weather Observations received by a ship would be transmitted to other vessels so that by means of such relays the weather conditions over the entire ocean would in a few minutes reach the central meteorological offices in the United States England, France, Germany, and other interested nations. Forecasts could then be made and distributed to the vessels by wireless telegraphy It is believed that a universal system such as this would be a great factor in saving life and property both on land and at sea. The conference has adopted an international weather signal code. Heretofore American vessels have used flags by day and lights by night to convey storm warnings while other nations have used balls and cones. Now any one will be able to read the weather signals, no matter what his nationality may be.

SCIENCE.

According to a recent report of the biological survey of the Department of Agriculture, rats destroy annually $100 000,000 worth of American grain It is estimated that one rat will eat 60 cents worth of grain in a year while of oatmeal it will consume $1 80 worth Rat proof construction especially the use of concrete foundations is urged as well as some rational method of disposing of garbage and storing food

Prof. John A Brashear of Allegheny calls attention to a peculiarity of the solar eclipse of June 17th For a few seconds it was an annular eclipse then a total eclipse and finally an annular eclipse again Although we have records of annular eclipses for four hundred years and of total eclipses for thousands of years Prof Brashear maintains that this is perhaps the first occurrence of the kind

The excavation of the Menelaion, the reputed tomb of Menelaus and Helen has brought to light some interesting Mycenæan relics among them traces of frescoes fragments of pottery bronze and lead votive offerings beads double-headed axes terra-cotta objects and the like The Menelaion itself was probably built about 5 B C in other words, six hundred years later than the traditional period of Menelaus.

Dr William Tell Kudlich has brought to the notice of the Health Board of Hoboken N J a plan for exterminating the mosquito which consists in planting mosquito-ridden tracts with azolla The plant is a native of Africa It in a short time covers marshy land with a layer three inches thick thus both suffocating mosquito larva and preventing the living insects from depositing their eggs in the water The plant is said to have been used with some success in the German colonies of Africa

In a process recently patented in Germany for the regeneration of vulcanized India rubber fragments of old rubber are mixed with from one-tenth to one-fifth their weight of anilin and the mixture is heated until it becomes fluid The special advantage of the process is the comparatively small quantity of solvent required The regenerated rubber is said to be little inferior to new rubber in elasticity and other properties It can be vulcanized in the usual way and can afterward be regenerated again by the new process.

The danger of explosion of mixtures of air and combustible dust is well known Explosions of this character occur in flour mills and frequently in coal mines Mixtures of air and aluminium powder are very liable to explosion The combustion of aluminium powder produces a very high temperature On this fact is based the process of autogenous welding of iron rails which is known as aluminothermy Recently in a factory near Nuremberg where a metallic surface is given to paper by means of aluminium powder the breaking of the globe of an inclosed arc lamp (Liliput) caused an explosion which killed two men and wounded several others

Experiments were recently made in France on various preservatives of wood including carbonileum Avenarius carbonileum Lyon gas tar, microsol lysol antimony antigermine and hydrofluoric acid It was found that for spruce beech poplar oak, and Aleppo pine exposed to the atmosphere the best preservatives are certainly the carbonileums gas tar and microsol The other substances examined produced absolutely no effect These same preservatives (carbonileum gas tar and microsol) are also most efficacious for the preservation of wood in the confined hot air of mines Antimony and hydrofluoric acid are less effective

Formol has been recommended as a fly poison by several writers who have studied its action and the best method of using it It is necessary in order to obtain good results that the formol shall be swallowed by the insect hence the flies must be attracted to the poison by mixing with it an appetizing food and by spreading the mixture over a large surface Honey has given poor results The best mixture is that of formol with milk The best results are obtained by using a solution containing 15 per cent of the formaline of commerce 20 per cent of milk and 65 per cent of water, placed in large flat vessels Most of the dead flies fall not within the vessels but around them sometimes at a great distance

An international agreement is reported between England France and the United States upon a unit of candle-power of luminous intensity to be known as the international candle No change is made in France which adheres to the *bougie decimale* nominally one-twentieth of the violle or molten platinum standard, but actually 0 104 carcel In England whatever small change may have been actually involved is covered by specifications of the national pentane flame standard by reference to the amount of moisture in the air of the photometer room In America a reduction of 1 6 per cent in the standard of candle-power maintained at the Bureau of Standards will be involved a change capable of being observed only by trained photometrists.

THE GUAYULE RUBBER INDUSTRY

BY J B KIRKWOOD

The increasing demand for rubber in the various manufactures of the present time makes the business of its production one of the most important of modern enterprises Not only is the natural source of the supply eagerly sought and carefully guarded but efforts for the cultivation of rubber bearing plants are receiving attention in many parts of the world

The rubber of commerce is derived from a number of different plants in fact there are many plants of more or less importance from the standpoint of the quantity and quality of the rubber they produce Among those less generally known is a Mexican plant called *guayule* (pronounced *wy lie*) which is identified botanically as *Parthenium argentatum*

The guayule is a desert plant It thrives in those regions of relatively little rain throughout the northern half of Mexico and the neighboring areas of Texas It is a small shrub tree-like and rarely attains a height of four feet or a stem diameter of more than three inches Its leaves are small and of a silvery gray color whence its specific name *argentatum* The plant produces small yellowish green flower heads consisting of many minute florets only five of which in each head are capable of producing seeds and each of these only one

Most of the rubber of commerce is produced by plants having a milky juice or latex as it is called in which the gum is found The trees are tapped by cutting into or through the bark and the latex is collected as it flows down In the guayule plant no latex is produced and it must be subjected to an entirely different process to extract the rubber This article occurs in the form of minute microscopic granules deposited throughout the tissues of the stem branches and roots but especially in the bark of these organs If one will take a very thin section of the stem or branch and examine it under a lens he may see much of the tissue densely crowded with small dark colored granules In these granules deposited within the living cell is the source of the rubber to separate which requires a special process

Methods of extraction of guayule rubber differ Some obtain the rubber by trituration of the plant and a subsequent more or less mechanical process others by means of solvents separate the gum from tissues after grinding them But the details of the process are kept secret the public not being admitted to the factories which are surrounded by high walls with armed guards at the gates However several processes are described by Dr F Altamirano* in the Boletin de la Secretaria de Fomento of Mexico One of the methods consists in first crushing the plants by grinding them in a machine in which they are tumbled among hard stones until thoroughly pulverized and the gummy substance collects in lumps with a certain amount of woody tissue To isolate the gum this material is then boiled over steam in an iron vessel with a double bottom and the woody particles afterward strained out After this operation the mass is thrown into a tank of cold water again it is strained and boiled anew with caustic soda until the woody particles are fully separated and the gum is precipitated by chloride of calcium

Extra large guayule bush

The process of extraction of guayule rubber involves therefore the immediate destruction of the plant. The natives employed to collect the plants uproot them and take no pains to spare any part The bushes are then packed on the backs of burros and carried to some place for baling and shipment The cheapness of labor makes it feasible to transport the plants for considerable distance by pack train or wagon. Sometimes the load is carried for as much as forty miles from where the plant is gathered to the railway station such distances usually by wagon The cheapness of labor makes such operations profitable the wages of a peon being about thirty seven cents a day Mexican currency

The manufacture of rubber from guayule is an industry of only recent development The production of gum from this plant has been known from the middle of the eighteenth century The Indians were accustomed to make rubber balls by chewing out the gum from the bark If one takes a mouthful of the bark and thoroughly masticates it rejecting the fibrous particles he may soon obtain a small mass of rubber the size of a pea The rubber thus obtained is soft and sticky adhering to the skin as it is manipulated between the thumb and finger

For some time no effort was made to manufacture this rubber on a large scale In 1890 a German chemist first attempted to extract it in commercial quantities but a paying basis was not reached until some years later In 1905 according to consular reports the guayule rubber shipment from Durango amounted to $125 478 From Torreon in 1906 rubber was shipped to the value of $917 571 During the year ending in June 1908 there was shipped from the Durango consular district alone guayule rubber to the value of two and a quarter millions Since then the business has increased and is one of Mexico s most important industries at the present time Extensive tracts of land and millions of capital are involved in the enterprise The Continental Mexican Rubber Company of New York in addition to their large factory at Torreon acquired possession of the old Hacienda de Cedros in the northern part of the State of Zacatecas consisting of 2 500 000 acres valued especially for the growth of guayule which it supports The Madero brothers of Barras

(*Concluded on page 26*)

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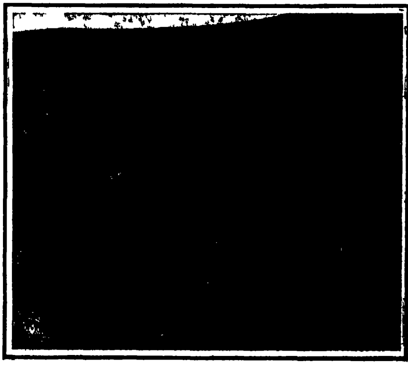
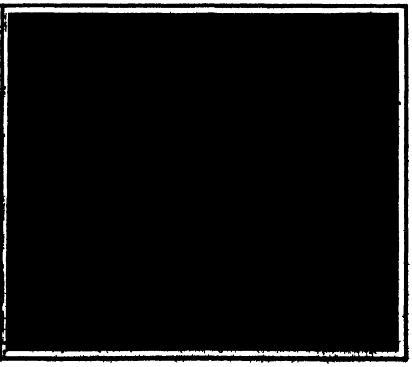
[*] Translation from the German of an article by Dr Rudolf Endlich published in Tropenpflanzer ix 1905.

Fourteen-mule team with load of guayule.

The guayule bush in the desert.



Bales of guayule ready for shipment.



Packing guayule into bales.

THE GUAYULE RUBBER INDUSTRY.

THE STANDARD ELECTRICAL CELL—ITS USE AND ITS PRACTICAL VALUE.

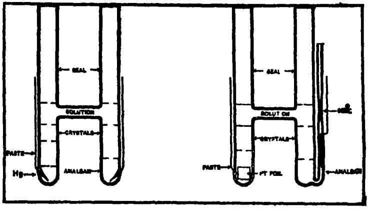
BY HERBERT T WADE

One of the most important lines of research in the field of electricity in recent years has had to do with the study of the standard cell from which is obtained a certain definite and constant electromotive force Indeed the standard cell practically underlies all measurements of electromotive force or difference of potential and its study and investigation have interested workers at the great national physical laboratories especially since the Clark cell was adopted as the standard of electromotive force in the definition of the volt by the Chicago Electrical Congress of 1893 To-day not only methods and results are compared by these national laboratories and bureaus but the very cells themselves are interchanged and a surprising degree of uniformity obtained on their comparison Now the standard cell in electrical measurements has the same function that a standard measure such as a scale or gage has in the shop and it must be used in the fundamental testing of a direct reading voltmeter and in other forms of laboratory work where accuracy in electrical measurement is essential While there are electrical units on the absolute system logically derived and inter-related and such practical units as the ampere volt and ohm yet it is just as difficult to reproduce and apply these units as it would be an inch or foot without recourse to some concrete standard

To realize the fundamental definitions and then to construct standards is a task requiring the most refined physical work but once the units are realized or known in terms of certain standards which may be reproduced readily and used in the laboratory accuracy of measurement follows without difficulty The standard cell enables us to define the volt as one of the fundamental units in addition to its general utility for electrical testing Various physicists and the investigators at the U S National Bureau of Standards have made a careful study of various types of these cells and it is their opinion that the standard cell has preponderating advantages over the coulometer as a fundamental standard However aside from this matter of defining the fundamental unit the present condition of the standard cell and its construction and testing present much that is of interest

The first standard cell or rather a constant cell in terms of which electromotive force was measured was the Daniell cell where zinc in a porous jar containing zinc-sulphate solution served as the anode while the cathode was copper in a solution of copper sulphate This cell was and is very useful as a constant source of current as in telegraphy having an E M F of about 1 1 volts but as a standard it was supplanted by the Clark cell devised by Latimer Clark in 1873

In its original form the Clark cell consisted of a test tube containing a mercury electrode covered with a paste made of mercurious sulphate zinc sulphate crystals and solution while above to form the second electrode was a rod of zinc in a saturated zinc sulphate solution and in contact with an excess of zinc sulphate crystals With an E M F taken as 1 434 volts at 15 deg C the Clark cell found wide usefulness and various improvements in the materials and form of construction resulted especially the evolution of the H type containing vessel and the substitution of zinc amalgam for the zinc rod due to Lord Rayleigh In 1893 the Chicago Electrical Congress adopted the Clark cell as a standard of electromotive force, and while international specifications for its construction never were prepared yet in the United States and in other countries legal specifications for making the cells were promulgated and the E M F was started at 1 434 volts at 15 deg C In the United States type a glass vessel in the shape of an inverted Y was prescribed in one limb of which was pure mercury and in the other an amalgam of zinc and mercury On the mercury was a layer of mercury and zinc sulphate paste above which as well as above the zinc amalgam was a layer of neutral zinc sulphate crystals and over all was a solution of zinc sulphate Somewhat different types of construction were adopted in different countries and in Germany the value of 1 4328 volts was adopted for the E M F which is nearer correct than the United States legal value Mention here should be made of the Weston cell brought out in 1892 which since has been widely used and studied both independently and in connection with the Clark cell In the Weston cell cadmium and cadmium sulphate replace the zinc and zinc sulphate of the Clark cell and the change of the E M F with temperature is so small as to be practically negligible For this and other points of advantage the Weston cell with its E M F of 1 1025 volts immediately found a place in the testing laboratory



Figs 1 and 2 Sectional views of standard cells

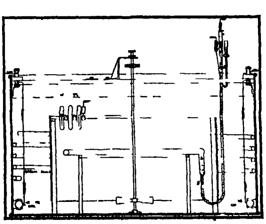


Fig. 3 —Sectional view of comparing bath.

Now while both of these cells could be made with ordinarily chemically pure" materials of sufficient accuracy for most ordinary work yet their permanence and durability as well as the limits of accuracy and reproducibility became a matter for investigation and this has continued with all the refinements possible in modern physical work The purity of the chemicals used has been determined beyond question and electrolytic and other methods have been used to obtain materials of absolute purity and uniformity even the size of the grain of the mercurious sulphate having received attention

The form of cell now made by the United States National Bureau of Standards is shown in the accompanying illustration Fig 1 a half-size diagram The size does not affect the E M F of the cell but it does determine its polarization and its power to assume quickly the temperature of its surroundings The lead wires are of platinum sealed into the tube and within are coated with a thin layer of glass to nearly the end Cracking at the point of sealing has always been a weak point with the Clark cell and this arrangement reduces the danger though the form of vessel serves equally well for the Clark and Weston cells

The Reichsanstalt or German Imperial Testing Laboratory recommends the form shown in Fig 2 in which the platinum terminal of the amalgam limb is sealed into a side tube into which the amalgam is sucked up while still liquid In a portable type of cell a piece of amalgamated platinum foil as shown in Fig 2 at the bottom of the left limb is welded to the platinum lead wire and replaces the mercury This type also has been extensively used by the Bureau of Standards The preparation of the chemicals and the construction of these cells involves the most painstaking care and the following of most detailed directions and of equal importance is their testing In the Clark cell especially the variation of the E M F with temperature requires special temperature regulating apparatus which enables the temperature of the oil bath in which the cells are placed to be maintained constant to within 0 01 deg C This is installed in a basement room of the Bureau of Standards where the temperature for the greater part of the year can be controlled automatically within 1 deg or 2 deg The illustration and diagram show the arrangement of the comparing baths and the regulating device which controls the temperature The various cells to be tested are immersed in the kerosene baths and their E M F is measured by the potentiometer method using a very accurate potentiometer of 10 000 ohms resistance and a sensitive galvanometer so that a difference of 0 00001 volt is plainly indicated on the scale In this arrangement a storage battery arranged across the terminals of the potentiometer provides a constant fall of potential Now by adjusting the coils of the potentiometer points can be found where there is no deflection of the galvanometer showing that the fall of potential of the standard cell is the same as that over a certain proportional part of the resistance of the potentiometer Both Clark and Weston cells thus were checked against each other and as a result of a large number of experiments and observations it was found that taking care that the mercurious sulphate was pure the remaining material of requisite quality could be obtained readily so that both types of cells are reproducible to within 2 or 3 parts in 100 000 These cells properly constructed gen

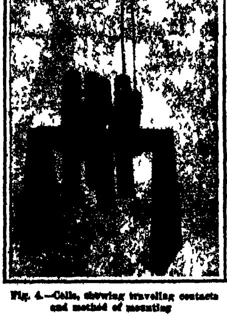


Fig. 4.—Cells, showing traveling contacts and method of mounting

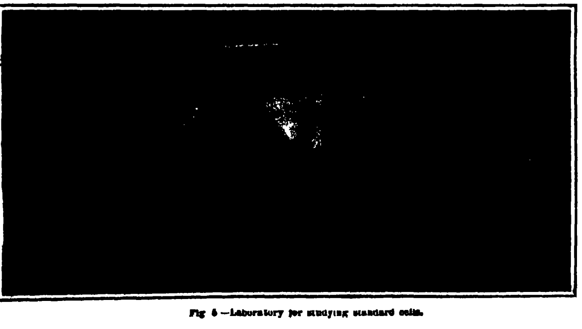


Fig 5 —Laboratory for studying standard cells.

THE STANDARD ELECTRICAL CELL—ITS USE AND ITS PRACTICAL VALUE.

erally reach a constant value within a few days and their E M F can be depended on within the above limits for at least a year

The investigators at Washington have studied not only their own cells made in various ways but also those of other investigators particularly those of the Reichsanstalt the National Physical Laboratory of Great Britain and the Laboratoire Centrale d Electricité comparison with the cells of these institutions having been made both in Europe and in Washington The conclusion was reached that standard cells could be set up by different investigators which will agree to within a few parts in 100 000 and that they can be constructed and carried considerable distances even on shipboard if ordinary precautions are observed

In the present condition of the standard cell the national laboratories can secure the desired accuracy and reproducibility and this extending in turn to the secondary standards must have its effect on electrical measurements If it is not feasible for the national laboratories and bureaus to construct these standard cells for ordinary testing or manufacturing laboratories it has been suggested that they might supply the materials of the requisite purity and thus obtain substantial harmony as the mere following of the specifications is not difficult while testing and certification by the Bureau would be a sufficient guarantee of accuracy The Weston cell which undoubtedly will be selected as an international standard of E M F at the coming congress though possibly without a legal numerical definition of its voltage to supplant the Clark cell of the present definition has now been demonstrated as a convenient standard and one easily reproducible with exactness It is for these reasons that many physicists especially those in America wish that the volt as defined by the standard cell should form with the ohm the two fundamental electrical units

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THE GUAYULE RUBBER INDUSTRY

(Concluded from page 24)

are said to own or control 3 000 000 acres of guayule lands and there are other large interests besides these

The rate of consumption of guayule is a subject of interest and importance With several well equipped factories in active operation working at least a part of the time both night and day the inroad upon the supply is a matter demanding consideration Although the acreage above cited seems large the fact is that only parts favored situations of these large holdings actually produce the plant the foothills especially of limestone formation A single factory may consume 30 000 tons of guayule shrub in a year or approximately 10 tons a day This may represent the growth on anywhere from [illegible] to 100 acres of land The number of plants on an acre and the weight of the individual plant vary so much that no constant figures can be given One may find on guayule lands a stand of from 1 000 to [illegible]000 plants to the acre and the plants weigh anywhere up to 15 pounds (very large) probably the majority of the plants taken weigh dry from 1 to 1 pounds Thus on an acre we should find from 1 000 to 8 000 pounds of the shrub If we call the average yield two tons per acre we may estimate the area harvested at fifty acres for one day s consumption at a large factory

While the fact is patent that the supply of guayule is decreasing and must ultimately be exhausted the opinions of experts place the date some at ten some at twenty years hence Large factories running steadily at Parras Torreon Saltillo and elsewhere using the product of no less than 100 acres every day the activities of the camps which the traveler may see in a dozen places in a day s journey the bales of the shrub piled high by the siding awaiting shipment all point to the speedily approaching day when the factories must shut down for want of material

This menace to the business interests involved has not been overlooked or ignored To provide a continuous crop upon which the business could depend is an idea that has appealed not only to the members of interested corporations but also to private land holders who appreciate the income prospective from such an enterprise Experiments here and there have been tried and various opinions have taken form as to the prospect The most notable of these experiments was that conducted at the instance of the Continental Mexican Rubber Company who recently established an elaborate department of investigation at Cedros Mexico and spent much money in forwarding the work Although less than a year was allowed for this large task the time sufficed to show some insuperable obstacles to the cultivation of the plant on anything like an economic scale

In the first place the slow production of seeds and the care required in their planting and the rearing of young plants make the procedure unprofitable from an economic standpoint With a possible germination rate of 10 per cent of the seed sown the failure through one cause or another of the young seedlings to pass the initial stages of development the ranks of the young plants again depleted by pest or parasite, the loss by accidents or in the process of transplanting, and a few subsequent vicissitudes both possible and probable make it doubtful whether one can count on as much as 1 per cent of the seed sown to mature plants even under the most favorable conditions Cuttings mostly fail to grow except from portions of the roots or stems having part of the root system in connection with them and only under certain conditions of irrigation even then as in the case of seedlings the cost of the operation exceeds its value Irrigation is quite essential to the starting either of seeds or cuttings and in the subsequent growth the rapidity of development depends upon the quantity of water supplied

But the rapidity of development is in inverse ratio to the formation of rubber in the tissues Plants grown under irrigation grow rapidly and attain in four years a weight of six pounds or more but the rubber content in such plants is practically nil while in native desert grown plants it is about 10 per cent of the dry weight If however water is withheld as under desert conditions the plants grow very slowly and it is doubtful whether a crop could be matured much under twenty years Of course rubber is present in desert grown plants at an age much less than this but it is a question at what age plants may be most profitably taken though certainly not in less than ten years

Reforestation by natural processes must be very slow and as in the case of the lumber forests of the North the second growth is never equal to the first A guayule seed in the desert has about one chance in ten thousand of coming up and thereafter danger from drought disease and accident make its hold upon life exceedingly uncertain The only hope of prolonging the business seems to be in so harvesting the plants that the roots are left in the ground from these new shoots will arise and in a few years possibly yield another crop worth the taking How long this process can be kept up profitably is at present unknown However the guayule rubber industry seems destined to have its day and pass out

The above statements are issued only after much observation and experiment the details of which are soon to be published in a book under the joint authorship of the investigators

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A 5 000 TON TESTING MACHINE

After the Quebec Bridge fell into the river it was found that the special member which gave way had failed under a load far below that which theoretically it should have carried The steel of which the bridge was built was of excellent quality and in the compression member which doubled up under its load there was sufficient steel for the purpose if it had only been assembled and braced together in the proper manner to develop its full strength The engineers who built the bridge believed that the box like form in which the plates of the bottom chord had been assembled and latticed together represented the strongest form of construction They believed that the latticing was quite sufficient to hold the deep webs or plates of the chord in true line and prevent just that very buckling which brought about the fall of the bridge

If we take a one inch cube of steel of the same quality say as that in the Quebec Bridge and subject it to compression in a testing machine it will begin to give way at a certain maximum load which represents the ultimate compressive strength of the material If we take another piece of the same steel one inch square and six inches long and subject it to compression in the direction of its longer axis failure will take place under a load less than that which was necessary to destroy the one inch cube Similarly if we take another specimen one inch square but twelve inches long there will be a still further decrease in the comparative compressive strength of the specimen As the length of the successive bars tested increases there will be a rapid decrease in their resistance failure taking place not as in the case of the cube by the actual crushing of the material but by the bending or bowing of the specimen away from its longitudinal axis If however as the length of the specimens is increased sufficient bracing be applied to prevent their bending from the straight line they will carry the same maximum load or nearly so as the first specimen measuring one inch on every side

Now in designing steel compression members, whether in the form of columns to support the walls of buildings or of posts or chords for steel bridges, an effort is made to so tie together the angles, plates etc of which they are composed that the steel will stand a compressive stress as near as possible to that which is necessary to crush a one-inch cube of the same steel Formulæ have been drawn up based upon tests to destruction of built up members of comparatively small size which are used in designing the big compression members that are too large to be placed in any existing testing machine All of the large bridges which have been built in this country during the past few years including the Quebec Bridge, have been designed by these formulæ which were formerly believed to give closely accurate results. Consequently, when the failure occurred at Quebec, it is not putting the case too strongly to say that it produced positive consternation among bridge builders, not only here but throughout the whole world. And although subsequent investigation of the bridge proved that it was overweight and that the latticing which failed was lighter and more openly distributed than in the judgment of many eminent engineers would be considered safe practice it is still a fact that if the commonly accepted theory of latticing was correct the bridge should not have gone down Hence there has risen a demand among bridge engineers for the construction of a machine large enough to take the biggest compression members and test them to absolute destruction It has come to be understood that only by this means will it be possible to draw up formulæ which will be absolutely reliable in the design of compression members of unusual size

Largely as the result of the agitation of this subject the United States Geological Survey is having built a mammoth testing machine which will have the large capacity of 5 000 tons. This powerful plant, which forms the subject of our front page engraving is now under construction for the Structural Materials Testing Laboratories of the Geological Survey by Olsen & Company of Philadelphia. The main purpose for which the machine is being built is the testing of large blocks of stone used for building purposes by the United States government It was also desired to obtain data regarding the strength of columns of brick concrete and structural steel Originally designed to take members 25 feet in length the machine is now being built to accommodate specimens up to 65 feet in length It will have a total weight of over 200 tons and its height above its foundation will be 80 feet. With a view to exhibiting its great proportions our artist has shown how the machine would appear if it were erected at the corner of Broadway and Vesey Street adjoining the southeast corner of the old Astor House which is shown in the illustration Although the machine has a total compression capacity of 5 000 tons it will not be capable of crushing to destruction a chord section of the Quebec Bridge or of the recently opened Queensboro Bridge in this city The drawings of these two sections have been introduced into the picture merely to show their huge proportions The Quebec Bridge section is shown adjoining St Paul s Churchyard and the Queensboro Bridge section is shown within the testing machine whose length is sufficient to include it

During the present Congress a bill was introduced but failed to pass authorizing the construction of a testing machine by A H Emery who built the celebrated 400 ton testing machine at Watertown Arsenal from which such great benefits have been derived This huge machine which will have a capacity in compression of 11 000 tons and in tension of 5 500 tons will be able to handle specimens one hundred feet in length Its total length will be 153 feet it will be 25 feet in width its weight will be about 3 500 tons and its cost would be $1 750 000 Had such a machine been in existence during the design and construction of the Quebec Bridge it is safe to say that the catastrophe would never have occurred

Returning now to the 5 000-ton Olsen machine as herewith illustrated the base contains a hydraulic cylinder or ram of 2 000 square inches cross-sectional area upon which is placed the lower platform From the four corners of the base extend four huge vertical screws each 13½ inches in diameter and 72 feet 2 inches in length At their upper extremities they pass through a massive upper head and are provided with four nuts which are operated simultaneously by means of gearing The maximum clearance between the upper and lower heads is 65 feet and the heads are each six feet square After the member to be tested has been placed on the lower head the upper head is brought down to a snug bearing on the top of the member and the pressure is then applied by means of a triple plunger pump connected to the main hydraulic cylinder in the base of the machine below the lower head, which to secure an even distribution of pressure, is provided with a ball-and-socket bearing The determination of the pressure which is being applied to the member tested is arrived at by means of a set of standard levers upon which is weighed 1/80 of the total load on the main cylinder, the reduction being secured by means of a piston and diaphragm. The weighing beam is balanced by means of an automatically operated weight, and it is provided with a device by which counterweights of one million pounds each may be successively applied The machine will stand upon a foundation of concrete eight feet below the floor line, and the top of the machine will be about seventy-two feet above the floor. The main hydraulic cylinder is fifty inches in diameter, and each of the 13½-inch main screws will weigh over twenty tons. The contract calls for an accuracy of at least one-third of one per cent for any load over fifty tons and up to the full capacity of 5,000 tons.

THE FOURTH DIMENSION SIMPLY EXPLAINED

THE FIRST HONORABLE MENTION ESSAY IN THE FOURTH DIMENSION COMPETITION

BY "[illegible]" (EDWARD H. CUTLER, NEWTON, MASS.)

[It was one of the conditions of the Fourth Dimension Competition that the editor of the SCIENTIFIC AMERICAN reserved the right to publish those essays which were considered worthy of honorable mention In accordance with that condition, the essay which in the opinion of the judges, Profs. S. A. Mitchell and H. P Manning, was deemed worthy of first place in the honorable mention class is here printed Prof Manning does not dissent for the most part from the conclusions of the author of the essay, but believes that the author has not quite fairly treated the arguments of the "fourth dimensionists." Prof. Manning will later offer some detailed criticism on this point.—ED.]

The fourth dimension has no real existence in the sense in which the external world that we know by means of our senses has real existence. It is a philosophical and metaphysical conception, whose actual existence cannot be demonstrated by observation or by logical reasoning. The existence of the fourth dimension is regarded by some as in a high degree probable, and as furnishing a basis for metaphysical investigation, and a means of explaining some physical phenomena, the occurrence of which, however, is not universally admitted. It may also, like any supposition, true or false, be made the hypothesis for mathematical speculations, which are comprehensible, however, by the very small and select number only who are endowed by nature with the ability to cope with original investigation in the domain of the higher mathematics.

The word "dimension" is more readily explained than defined. All more or less clearly conceive of space as extending indefinitely or infinitely in every direction, and of extension in space there are three "dimensions"—length, breadth, and thickness. Or, in another point of view, having three fixed points from which to reckon measurement, by three dimensions or measurements we can fix exactly the position of any point in space Thus, if the three fixed points be the center of the earth, one of the poles, and some other point on the surface, as the location of the Royal Astronomical Observatory at Greenwich the length of the line drawn from the center of the earth to the point in question in space, as a star, however remote, and the latitude and longitude of the point in which the line from the center intersects the surface, will be three dimensions, which fix exactly the position of the point in space, or of the star Or again, starting from any point in space, we may reach any other point by proceeding successively in three directions at right angles with one another Thus, moving from the starting point, first the proper distance east or west, then from the point arrived at the proper distance north or south, and finally the proper distance up or down, we reach the second point in question

In all the ways in which the meaning of the word is thus illustrated we see that we can have no fewer and no more than three dimensions, but the believers in a fourth dimension infer its existence from analogy in one of the following deductive processes

(1) Conceive, we are bidden of a space of but one dimension. A being in such a space would be limited to a straight line, which he would conceive as extending infinitely in both directions. His only possible movement would be along this line, and if he encountered another being, neither could pass the *other* If he is really within a space like ours, although his perception is confined to one direction only, and a being in our space should lift one of the two beings, and place him on the other side of the first, the latter would lose sight of the other as soon as the lifting took place, and the movement by which the change of position had been effected would be utterly unintelligible to him

Conceive of a space of but two dimensions like the flat surface of a table. Beings in such a space could move around one another, but one of them completely surrounded by others would be imprisoned by them. If, as before, the two-dimension space is within our space, and really depends on the limitation of the perceptive faculties of the beings in question the imprisoned being could be lifted by a being in our space, and set down outside of the beings surrounding him The latter would lose sight of him during this movement, and could not understand how it had been effected

From these suppositions of one-dimension space and two-dimension space, the inference is drawn that there may be a fourth dimension in our space, and that our ignorance of it arises only from the limitation of our perceptive faculties.

These suppositions, however, involve a fatal confusion of mathematical with physical conceptions. Mathematical lines and plane figures do not, like matter, occupy space, and they present no obstruction to the movements of one another They may freely intersect, or pass through one another, or coincide wholly or in part with one another If these suppositious beings in one or two-dimensional space [illegible] obstruction to their movements, it must be [illegible] occupy space, and therefore are really in three-dimension space, however little they extend except in one or two directions. A line or a plane surface can be conceived only with space around it in every direction. The supposition of a one-dimension or a two-dimension space is therefore impossible except as a mathematical abstraction, and furnishes no basis for belief in a fourth dimension.

(2) The straight line, a one-dimension magnitude ends in points, the square a two-dimension magnitude, is bounded by straight lines, one-dimension magnitudes, the cube a three-dimension magnitude is bounded by squares, two-dimension magnitudes It is inferred by analogy that three-dimension magnitudes bound four-dimension magnitudes, although the latter are not known by us. Thus the "four-dimensional cube" receives a name, the "tessaract," and is said to be bounded by cubes

But there is no such analogy as is here assumed All lines end in points, although some lines, like circular arcs, require two-dimensional space, and others, like a corkscrew curve, three-dimensional Nor are all two-dimensional figures bounded by straight lines The bounding lines *of circles and ellipses, for example*, require two-dimensional space, as much as the figures themselves. Still further, solids like spheres or egg-shaped bodies are bounded by three-dimension surfaces. There is, therefore, no regular progression which would lead us to suppose the existence of magnitudes bounded by solids. In fact such a supposition is inconceivable. The only possible boundary of a solid is a surface, whatever be the number of the dimensions of space.

(3) *In the series of the successive powers of a* number, a, a^2, a^3, a^4, a^n, a may be represented graphically by a straight line, of which a denotes the length, a^2, by a square, of which a denotes the length of a side, a^3, by a cube, of which a denotes the length of an edge. It is inferred that if we keep on there must be a magnitude corresponding with a^4, and so *on indefinitely up to* a^n Such magnitudes are incompatible with three-dimension space, and suggest for their possible existence 'spaces of higher order'"

To those who have some elementary knowledge of analytical geometry or even of the use of graphs in algebra the origin of the conception of spaces of higher order may be presented in a different way As an equation containing two "variables" may be considered as representing the locus of a series of points in a plane so an equation with three variables is the locus of points in space, referred to three rectangular axes. But since, as shown above, in explaining the word 'dimension," three dimensions or co-ordinates fix definitely and exactly the position of a point equations with more than three variables transcend the scope of our geometry, and require for analogous interpretation spaces of more than three dimensions.

There is no objection to the hypothesis of spaces of a "higher order" as a purely mathematical conception, but this abstract supposition has no bearing on the number of dimensions of actual space as we know it.

(4) If we connect by a straight line the upper extremities of a capital V, we form what is called an isosceles triangle If we connect the middle point of our line with the bottom point of the V we have divided the *triangle* into two triangles which are plainly equal If we were confined to the two-dimensional surface of which the triangles are a portion we could never move them about so as to apply one to the other, and prove them equal by coincidence Not being under this restriction but being in three-dimension space, we turn one of the triangles a half revolution on one of its sides and then the two figures may be made to coincide Now there are many symmetrical solids for instance the two hands, which can never be brought *into identical shape* We cannot prove the left hand equal to the right by putting on the left the right hand glove But if we turn the right hand glove inside out it will fit the left hand Just as we can prove two-dimensional figures equal by availing ourselves of the possibilities presented by three-dimensional space it is inferred that in four-dimensional space, not only the glove, but the hand within it, might be turned inside out and made identical in shape with the other hand No explanation is offered of the way in which an additional dimension would render such a eversion possible, and if we could admit that it would do this we are not shown why the actual existence of a fourth dimension follows. Some four-dimension enthusiasts appear to believe that symmetrical forms in organic bodies could not originate without a fourth dimension, but no reason is given for this belief

The four numbered sections above include virtually all the lines of thought along which the effort is made to substantiate the existence of a fourth dimension Metaphysical considerations are sometimes added of the uncertainty and possible inaccuracy of our conception of space, but with no suggestion for correcting this inaccuracy, and no argument for the belief in a fourth dimension Admit that the mind must itself contribute an *a priori* element to all knowledge, and that the truth of things is not limited by the phenomenal apprehension of them it does not follow that this apprehension is to be assumed without demonstration to be false or incomplete In an investigation like the present one it is unnecessary to consider whether our conception of the *non ego* is subjective or objective we must accept the world of matter and of mind in which we live as our perceptions present it *to* us, and as it is generally conceived. No observation has ever discovered the existence of a fourth dimension in space and it may safely be said that there is no reason for believing in its existence

The theory of spaces of a higher order as developed in section (3) above is entirely legitimate as an abstract mathematical conception but *furnishes* no basis for the supposition of a fourth dimension in our space It virtually assumes space as we know it to be three-dimensional yet *from* a suggestion arising from this theory apparently (for no other origin for the assumption is to be found) the four dimensionists *have made* space as we know it a space of the highest order for the same analogies and inferences on which they depend would lead us to a fifth a sixth an nth dimension A fourth dimension belongs (or rather four dimensions belong) to the theoretical four-dimension space, but mathematics furnishes no basis for ascribing to our space more or fewer than three dimensions.

The confusion of thought of the four-dimensionists characterizes their writings on the subject The most thorough-going devotee of the fourth dimension asserts "There is nothing mysterious at all about it From every particle of matter there is a new direction, not connected with any of those which we know, but independent of all the paths we can draw in space and at right angles to them all" It would seem indisputable that a direction at right angles with all the paths or lines that we can draw in space from any point would produce lines coinciding with all the lines drawn from the point and therefore giving no 'new direction' But we do not need to be convinced that there is no 'direction' from which we are cut off, and in which we cannot direct our perceptions.

The attempted analogies described in section (1) above are those on which the four-dimensionists chiefly depend, and they rely upon them to show that *a fourth dimension would explain how a body may* become invisible They assert that a body would disappear on 'entering the fourth dimension This expression is manifestly unintelligible Every body extends constantly in all the dimensions of space we cannot think of it as entering the dimension of length breadth or of thickness or of entering the fourth dimension if there were one But the disappearances produced as in section (1) depend wholly on removal from the limited perceptive faculties of the supposed observers but our normal perceptions are unrestricted in direction and extend to every point in space, unless cut off by distance or by an interposed physical obstruction If all the particles of a body moved in the 'new direction' of the imaginary fourth dimension the body would still retain its length breadth and thickness and would still remain within the range of our perceptions.

The assertion is made on the authority of eminent mathematicians that in space of four dimensions *there would be no obstruction to entering or emerging* from space shut in on every side as a tightly shut box or room and the fourth dimension is relied upon to explain supposed mysterious occurrences of such entrance or emergence The modification of physical laws in spaces of a higher order those of unusual mathematical ability alone can be expected *to understand* and in the special instance in question no explanation is vouchsafed Until such explanation is given, those who can make no claims to exceptional mathematical talent will be unable to believe it possible, in space of the fourth, or of any order to extract the contents of an egg or to pass an object within the egg and at the same time leave intact the continuous material structure that we call the shell But whatever may be possible in theoretical spaces of higher order we need not accept an unintelligible fourth dimension to aid in the explanation of something equally unintelligible

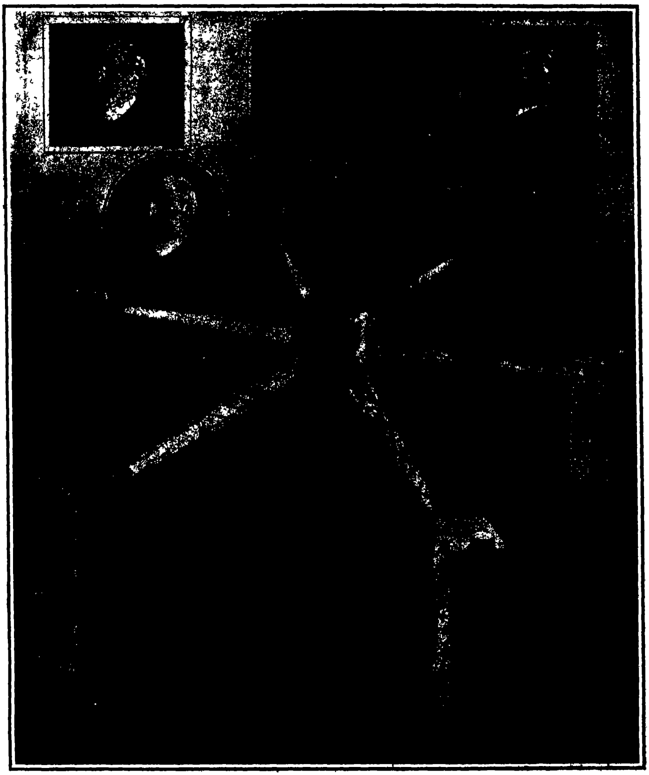
It may be said in conclusion that the only 'explanation of the fourth dimension *that can reasonably be given*, is to say that in the sense in which the expression is used, the fourth dimension is absolutely non-existent. It could have meaning only to designate the dimension in addition to the three that we know belonging to the imaginary mathematical hypothesis of four-dimension space The fourth dimension" *has no relation to the actual* universe in which our sensations and perceptions are exercised and belongs to that realm of thought to be entered only by the select few whose exceptional genius includes the development of the mathematical magination.

CARVING STATUES BY MEANS OF PHOTOGRAPHY

BY J HAMMOND SMITH

The device illustrated is intended for use in the production of all kinds of statuary, where it is possible to use the original as a model or where it is possible to arrange a model after the original idea Its principal use is in copying from life and existing statuary It is especially useful where a likeness may be desired and where variation of relative sizes of the statue from the model may be necessary For instance a man may be used as a model and his exact likeness produced in a statue of any reasonable size smaller or larger than the man himself

The device is composed of combined cameras and projecting lanterns which I call camera-projectors These camera-projectors are located in suitable positions about and at variable distances from a common center where the model is located In the illustration the camera projectors are located in a horizontal plane about the central bust These instruments are adjustable along radial lines Other adjustable camera-projectors with their optical axes passing through center may be located at any desirable points



The dimensions of the model are recorded photographically on a plate or screen. The plate or screen is used to project these dimensions on a block of wood or stone. The sculptor carves away enough material so that the images projected from two cameras coincide.

CARVING STATUES BY MEANS OF PHOTOGRAPHY.

The plates on which the contours and dimensions are recorded as well as the plates for the illumination of the finished statue are obtained photographically as follows Screens like the one shown in positive at the top of the engraving are placed in a number of the camera projectors Then all extraneous light is shut out and these used as lanterns to project images of the screen on the model, which is located at the center The other camera projectors are then used as cameras, in which photographic plates are exposed Thus photographs of the model while illuminated with the screens are obtained The screens are then removed from the lanterns, and the model illuminated by the lanterns or from some outside source, as flash light or daylight and other photographs of the model still in the same position are taken, to be used in the illumination of the finished statue. These plates may be stored away in small space for any length of time and then brought out for the production of the statue of the model and its illumination

The method of producing the statue, after the photographs have been taken, is as follows After the plates have been developed and dried they are returned to their respective positions in the camera-projectors. Then the instruments are used only as projecting lanterns, and generally only two at a time. If the statue is to be smaller than the model, the instruments must be moved nearer the center; but if it is to be larger than the model, the instruments must be moved farther away from the center, the distance depending on the size of the statue desired

The statue is built up or carved out by locating points by the intersection of light beams from the lantern with corresponding beams of the same marks or symbols of the screen, coming from the camera, which is now being used as a lantern. When the photographs were taken, certain marks on the screen were projected on the model by the lantern. These marks were photographed on the plates of the cameras. When these plates are developed, and replaced in the camera, and the camera used as a lantern, the same marks will be projected on a surface located in the same position as the model when the photographs were taken. Therefore if both instruments are used as lanterns, the two projections must coincide on a surface located as the model formerly was. For instance, suppose lantern 2 projects the letter *O* of its screen on the model. The letter *O* is reflected to camera 3, and the impression on the photographic plate is the letter *O* Now with camera 3 used as a lantern, and with the developed negative in the same place as when the photograph was taken, an image in white, of the letter *O*, will be projected from 3, and will exactly cover the image in black of the letter *O* projected from 2. But it will be noticed that these two images will coincide only when the model, or a statue of the model, occupies the same position and space as was formerly occupied by the model when the photographs were taken. If this part of the surface of the statue is too far from the center, the black image of the letter *O* from 2 will appear to the right of the white image of the letter projected from 3 But if the surface is too near the center, the black image will appear on the left and the white image on the right. Therefore, in making the statue, corresponding images projected from the two instruments must be made to coincide, by building up or carving out the material of the statue. Lights of different colors may be used in the projecting instruments to heighten the contrast of the two images.

A set of negative plates (the original plates) may be used in all instruments in making statuary or a complete set of positive plates may be used In either case the black markings from either projection will be superimposed by the white markings from the other projection The positive plates are found most convenient to use, on account of the positive image of the model thus obtained

The finished statuary may be illuminated by simply using the camera-projectors as projecting lanterns, using slides made from the second set of negatives exposed while photographing the model instead of projecting the image of the model on a flat surface, as is ordinarily done, producing a flat picture, the image is projected on the statue at just the proper angle and distance to enhance the likeness of the statue to the original model Thus a projected picture and a statue, both of which bear likeness to the original model, are combined, producing a likeness which cannot be attained by picture or statue alone. When a statue is to be illuminated in this way, a number of small projecting lanterns must be installed in the exhibit place, at the proper angle and distance with respect to the statue, to produce the proper illumination These projecting lanterns must have the same optical arrangement as the standard camera-projectors used in making the statuary They may be mounted in ornamental pendants, pedestals, walls, or columns

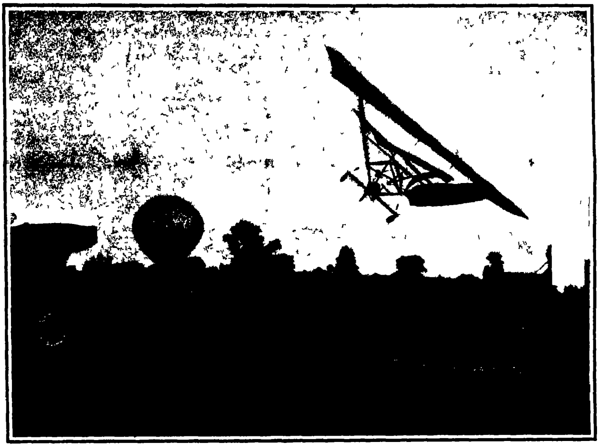
With the artificial illumination of the statue, which is a part of the system, a most natural and lifelike appearance is obtained Thus two distinct effects are produced by the statuary, one effect in daylight as ordinary statuary, and another and entirely different effect when the illumination is produced artificially.

THE FIRST FLIGHT EXHIBITION AND TOURNAMENT OF THE AERONAUTIC SOCIETY

As noted in our last issue, the first opportunity to witness aeroplane flights in the vicinity of New York city was given the public on June 26th at Morris Park. Several very successful flights were made that day by Mr. Glenn H. Curtiss with the new biplane he has built for the Society, the longest of these being almost a complete circuit of the Morris Park race track in about 1½ minute A half dozen other new aeroplanes, built by members of the Society, were exhibited, and one of these was shot off the catapult in an effort at flight.

Next to Curtiss's flights the most sensational feature was a towed flight in a glider made by Mr William H Martin of Canton, Ohio One of our illustrations shows this flight, while the other shows the flight made by Curtiss The glider was towed at too high a speed by the Kissel car employed for this purpose, the result being that it swayed violently, from side to side, tipping up as shown in the photograph, and finally crashing into the fence when the tow rope broke Fortunately, save for a sprained wrist, Mr Martin was uninjured He has repaired his glider and expects to try it again at the next meet on July 5th At the same time Mr Curtiss will attempt to set up a record for 1909 for the SCIENTIFIC AMERICAN Trophy—a record which, if unsurpassed this year, will entitle him to be declared the winner for the second time, and make it necessary for him to win it only once more to become the permanent holder

The fact that even those most skilled in the art will not attempt flight with an aeroplane as yet except under the most favorable conditions, was brought out by the failure of the Wright brothers to try their machine for the first time late in the afternoon of June 28th at Fort Myer, because a light breeze sprang up at the last moment. Congress had adjourned specially so that its members could witness a flight, and most of its members had been present at the Fort Myer parade ground all the afternoon, waiting in the broiling sun. It was a terrifically hot day, and when the breeze came it was welcomed by the spectators, but not by the Wrights, who refused to attempt a flight with their new machine save in an absolute calm The following two days only short flights of a few hundred yards were made, the engine developing insufficient power to make turns. Some damage was also sustained in alighting



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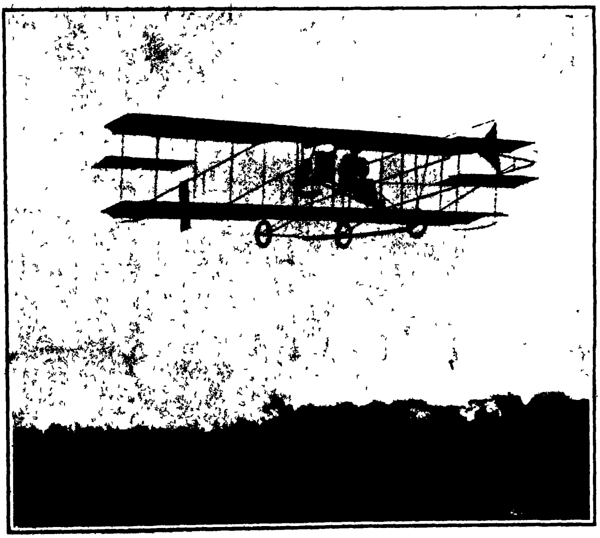
The Martin glider towed by an automobile at Morris Park.

The photograph shows the glider tilted to one side and swaying badly owing to the high speed at which it was being towed The rope broke and the glider crashed through the fence just after the picture was taken



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Curtiss flying on his new biplane, built for the Aeronautic Society, at the Society's grounds at Morris Park.

The photograph was taken just before making the turn during the first circular flight on June 26th

THE FIRST FLIGHT EXHIBITION AND TOURNAMENT OF THE AERONAUTIC SOCIETY

The Current Supplement.

The opening article of the current SUPPLEMENT, No. 1749, gives a description of a novel railway testing machine. Col Sir Frederic L Nathan contributes an authoritative paper on guncotton and its manufacture Marine producer gas power is a subject very much in the engineering eye at present and is discussed by Mr C L Straub Roger B Whitman of the New York School of Automobile Engineers has prepared a handy testing chart for automobilists which tells the chauffeur what to do when the engine stops A description is published of the casting of a colossal statue for the monument to King Victor Emmanuel II Wilhelm Krebs writes on how the earth looks from the moon supplementing his explanation with excellent drawings. S Frank Aaron contributes an instructive article on cocoons The sea carbon dioxide, and the duration of human life on the earth is the subject of an interesting article by J C Greggory

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Ingenious men are continually contriving new kinds of shoes, new suspenders and hundreds of different kinds of braces but so far no one has taken up the idea of making a hat which will hold on the head and not blow off and at the same time not bind the head all around like a constricting band Some one ought to invent a hat which will prevent baldness Hundreds of remedies are on the market which are advertised as sure hair restoratives but not one of them will bring back one hair once the hair follicle is atrophied and functionless nor will any of these remedies prevent the falling of hair unless the habits of the sufferers are changed At best these remedies are merely skin irritants which promote a slightly increased flow of blood to the scalp Dandruff cures are mostly fakes The only good accomplished by these medicaments is the scalp massage indulged in while applying them, and the practitioner should make a fight against their use.—Dr T O Cobb, in the N Y Med Jour

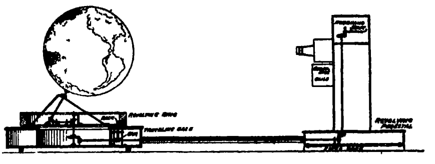
A HUGE PLANETARIUM.

BY GEORGE SHERWOOD HODGINS

A wonderful object lesson on the movements of the earth may be had by any visitor at the American Museum of Natural History in New York. The relations of the earth and sun are represented by a model erected under the supervision of Dr H C Bumpus director of the museum The mechanical details have been very carefully worked out by Mr H F Beers an expert mechanician on the museum staff The globe representing the earth is about four feet in diameter made of paper and turning on its axis once in 24 hours The sun is represented by an electrically lighted stereopticon lamp of 3000 candle power which throws a divergent beam of white light upon the side of the globe turned toward it The lamp is placed on a revolving stand in the center of the hall and the 92 700 000 miles which separate earth and sun are here reduced to a distance of about 14 feet

The light hollow paper sphere showing land and sea is carried on a steel shaft supported by an iron frame which rests upon a revolving wooden ring This ring, turning on a ball race rests on a traveling base mounted on castors which roll upon the floor The motive power for the miniature world is a Howard steeple clock such as is used in churches The clock is inclosed in a glass case the pendulum swinging in a cabinet below The cabinet stands on a circular wooden pedestal and like the revolving wooden ring below the globe the pedestal rotates on a ball race The clock cabinet also carries the stereopticon lamp so that lamp and clock rotate together on the fixed base The work done by the clock is probably less than that which would be required in moving the eight hands of a tower clock The minute hand shaft is not used and this clock steadily turns only the shaft usually employed to drive the hour hands As the globe is required to revolve but once in 24 hours a pair of gear wheels is interposed so that the hour hand shaft moves as it would for a clock having 24 hours shown on the dial.

No dial is used however and the slowly driven hour hand shaft terminates in a 45 deg bevel gear, just behind the lamp This bevel wheel meshes with a similar gear on the upper end of a vertical shaft which shaft therefore turns in unison with the hour hand shaft of the clock At the bottom of the vertical shaft a pair of 45 deg bevel gears transmit similar motion to a long horizontal shaft laid in the hollow of a 4 inch channel iron which connects the revolving pedestal of the clock with the traveling base below the globe In the center of the traveling base a third pair of 45-deg bevel gears give the motion of the horizontal shaft to a short upright shaft, and a fourth pair of 45-deg bevel gears at the top of the upright shaft transfer the motion to a short horizontal shaft All these shafts are carried on bicycle ball bearings The connection between the short horizontal shaft and the axis of the globe is made by a pair of specially cut bevel gears so that while the axis of the globe receives its motion from the clock, through the intermediate shafts and gears the specially cut bevel wheels preserve an angle of 23 deg 27 min from the vertical for the axis of the globe The complementary angle 66 deg 33 min at which the axis of our earth is inclined to the ecliptic or plane of its orbit about the sun is thus maintained The axis of the globe is placed like that of the earth so that it points toward the pole-star in the heavens The globe is therefore made to turn upon its axis once in 24 hours and with the same axial tilt as that of our planet and with its poles directed as are those of Mother Earth



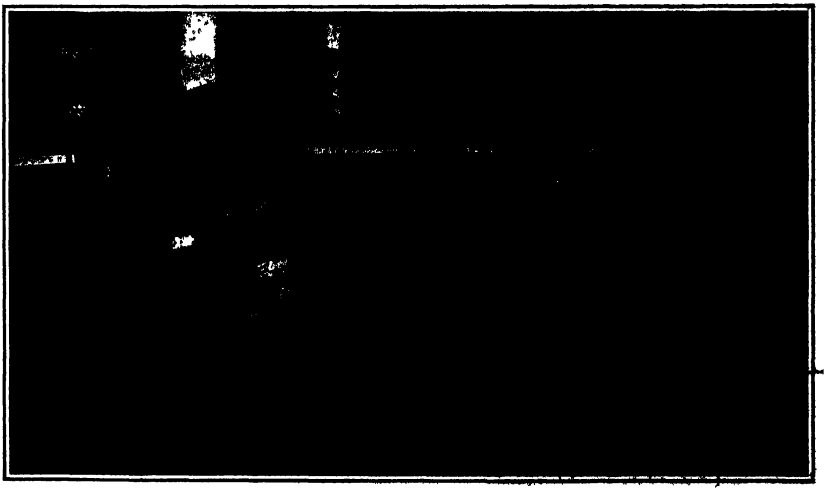
Section through the planetarium

The divergent beam of light from the lamp bathes one-half of the globe in bright light while the other is enveloped in the comparative gloom of the hall Thus the recurrence of day and night is made plain to the beholder The equator of the globe is divided into twenty four spaces with fractional divisions for half and quarter hours, and the shadow from a wire in front of the lens of the lamp draws a meridianal line upon the globe This shows the advance of high noon in the center of the illuminated surface, as the globe turns continuously from west to east, as does the earth During the time the earth is making one complete revolution on its axis, it is swinging on in its vast journey around the sun. The rate of this motion has been calculated by astronomers as about 18 miles a second

If the earth did not revolve around the sun, one complete axial revolution would be made in 23 hours and 56 minutes. In other words, the meridian passing through New York would be back again under the central beam of light from the sun in 4 minutes short of 24 hours and the corresponding meridian on the globe would coincide with the shadow line from the lens, in just that time. The earth, however, has in one day been carried forward more than a million miles in its path around the sun, and the meridian of New York is therefore behind the central beam from the sun by about 4 320 miles and 4 minutes more are required to bring this meridian under the central beam, indicated by the shadow line, and so completes one revolution which we call day and night. The period of 24 hours is called the solar day while the shorter period is the sidereal day

The constantly north-pointing direction of the earth s axis is also represented and maintained by the globe through a cleverly devised arrangement. On the underside of the revolving wooden ring below the globe a circular rack is fastened, and a suitably proportioned spur wheel gears with the rack. On the long horizontal shaft in the channel iron there is fixed a cam or dog, which revolves with the long shaft. The cam has one tooth, which engages with the spur wheel at every revolution of the long shaft The contact of cam and spur wheel gearing with the rack moves the wooden ring which supports the globe the distance necessary to preserve the position of the axis of the globe always pointing north

The requisite movement of the traveling base is made each day by the museum attendants The advance of the base represents the orbital motion of the earth in one day On the model this amounts to 3 inches All round the planetarium there is a protecting handrail On the inner face of the handrail a series of divisions is marked off each corresponding to a day The whole circle of the handrail approximately indicates the earth s path around the sun The top of the handrail is divided into 360 spaces representing the degrees of a circle. If there were only 360 days in the year, the divisions for days and degrees would correspond There are 365 days in the year and 360 deg in a circle The divisions representing the days are each smaller than the space occupied by a degree This slight discrepancy between each of them increases as the circle of the handrail is followed round At the end of the year the accumulated difference is practically equal to a quarter of a division representing a day, and thus the visitor has ocular demonstration of what leap year [illegible], by the adding of one day to every fourth year.

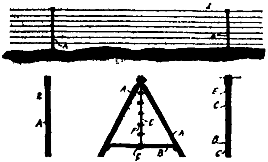


THE GREAT PLANETARIUM OF THE AMERICAN MUSEUM OF NATURAL HISTORY.

Patent Department

PORTABLE METAL FENCE.

The growing scarcity of timber demands economy in its use, and the employment of substitutes for wood wherever possible. This is one of the reasons why wooden fences are giving way to metal constructions. Other and more potent reasons are because the metal fence is stronger, less liable to deteriorate, less cumbersome, and generally more ornate One of the latest constructions, which is very interesting, is pictured in the accompanying engraving This fence is unique in that it is portable. The fence posts are built up into an A-shaped form consisting of two side members *A* of metal tubing, which are flattened at their upper ends and bolted together, while their lower ends are spread apart by a member *B* A central plate *C* is fastened between the upper ends of the members *A* and is secured to the member *B* by means of a wire This plate *C* is provided with a number of openings *E* to receive the eyebolts *F* The fence wire is strung through these eyebolts, the uppermost wire resting on top of the plate *C* in the slot formed between the members *A* If desired, the eyebolts *F* may be dispensed with, and the wires can then be strung through the apertures *E* As the posts are merely set on the ground and not imbedded in it they may be moved to any desired position The inventor of this fence has called our attention to the fact that the ground on each side of an ordinary fixed fence becomes a breeding place for weeds, briers, and undesirable grasses, whose seeds ripen and are spread broadcast over the adjoining land The portable fence however may be moved to one side when the field is being plowed so that every foot of land may be cultivated Mr Calvin Wilson of 1004 Park Avenue Richmond, Va has secured a patent on this portable fence



PORTABLE METAL FENCE.

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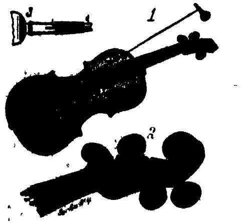
IMPROVED HEAD FOR STRINGED MUSICAL INSTRUMENTS.

The object of the improved head for stringed musical instruments which is pictured in the accompanying engraving is to enable the player to string the instrument when necessary without loss of time The pegs on which the strings are tightened may be removed from or replaced in the head without detaching the string and in case of a string breaking a new string may quickly be applied It will be observed that the head is in the form of a box with holes passing through the sides to receive the pegs, but notches are cut through the sides, leading to alternate holes. The string is knotted at one end in the usual manner so that it may be readily caught in the tailpiece while the opposite end is fitted into a slot in the peg and is wound thereon The peg is seated in the head by inserting its inner end into the hole and lowering it [illegible] through the notch into the opposite hole. The string is then tightened until it has been properly tuned. Thereupon the peg is jammed into the hole so as to prevent it from turning It is the object of the inventor to provide a number of pegs each wrapped with a string so that in case of a string breaking the old peg may be lifted out of the head and the new string and peg inserted in its place. In this way the operation of replacing a string will consume a minimum time and will not seriously interrupt the playing, particularly in an orchestral production The actual time consumed in taking out a broken string, putting in a new one, and tuning it is 15 seconds. The operation can be performed in the dark The holes and the notches for the pegs are tapered to correspond with the taper of the peg so that when the latter is tightened to a sufficient degree and jammed into the hole it will be held in place with the requisite friction The construction does not limit the head to any particular form It may be made plain as in Fig 1 or with the usual fancy scroll as indicated in Fig 2 Mr Arthur S Leslie, of Sapperton, British Columbia Canada, is the inventor of this new form of head for musical instruments



IMPROVED HEAD FOR STRINGED INSTRUMENTS.

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New Use of Paper.

Germany manufactures annually 425 000 tons of paper, England 260 000 tons France 190 000 tons Austria 155 000 tons and Italy 120 000 tons. But the United States makes and uses more paper than all Europe, the annual production amounting to 1 330 000 tons. A French journal mentions the following novel uses of paper in America

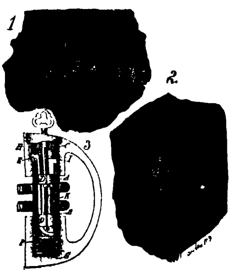
Roofs of paper and compressed wood pulp have proven successful A Chicago firm makes paper garments which are so light flexible and convenient that they are largely used in hospitals The paper is made of the bark of the paper mulberry tree and is tubsized and finely craped Several sheets are superposed and sewn together The garments have narrow woolen bindings buttons, buttonholes and other fastenings Paper cigars are made by steeping paper pulp for ten days in a decoction of cigar clippings passing it between cylinders and rolling the sheets into the form of a cigar

Paper bottles and grain bags are made in Philadelphia. A recent invention is the paper horseshoe which according to the inventor is more durable as well as lighter than the iron shoe and eliminates all danger of injury to the hoof as it is attached not by nails but by cement Two German engineers have invented a sort of reinforced paper composed of paper pulp canvas linen and raw silk reinforced with steel wire The new material is light waterproof fireproof and suitable for the construction of vessels including warships automobiles and other vehicles for railways, street pavements and many other uses

◆

PADLOCK WITH INCASED BOLT

A padlock as commonly made offers but slight security against thieves. The lock itself may be of most elaborate construction so that it is well nigh impossible to pick it but that matters little when the door can be opened without touching the lock merely by filing or sawing off one of the screw eyes through which the bolt is passed The weakness of the padlock lies in the fact that the screw eyes and bolt are unprotected This weakness is very cleverly overcome in the lock herewith illustrated by having the casing of the lock extend over the bolt and screw eyes, completely inclosing them The casing is made in two forms, one for double doors which is of hemispheroidal shape (Fig 1) and the other for single doors, which has the form of a section of a sphere (Fig 2) The screw eyes with the bolt passing through them are shown in section in Fig 3 It will be observed that the casing fits very snugly against the doors and its form is such as to offer very little grip for a tool, should anyone attempt to force the lock The locking mechanism is contained in the bolt as shown in sectional view, Fig 3 The bolt comprises a cylindrical barrel *A* into which is fitted the sleeve *B*, the latter being formed with a head *C* through which the key is inserted Within the sleeve are the tumblers and locking dog mounted in a pair of heads *D* which are secured to a central stem The locking dog *E* is fulcrumed in the lower head *D*, and is provided with a curved extension against which the plate *F* is pressed by the coil spring *G* The spring *G* causes the upper end of the dog *E* to project through an opening in sleeve *B* and barrel *A* and to enter a recess in the casing of the lock, thereby retaining the bolt in the locked position To unlock the bolt it is necessary to turn the heads *D* within the sleeve *B*, so that the dog will be brought into register with the slot indicated by dotted lines at *H* and the spring *G* will then force out the sleeve with the mechanism it contains to the position shown in Fig 1 The bolt may then be drawn out by taking hold of the projecting sleeve The tumblers *I*, which are mounted to slide in heads *D*, enter bayonet slots in the sleeve *B*, and normally prevent the dog from turning until they have been forced down against the pressure of springs *K* sufficiently to enter the lateral extensions of the bayonet slots The barrel of the key is slotted so as to press the several tumblers to exactly the required extent. Then when the key is turned the tumblers and dog will be turned Any number of combinations may be had by changing the depth of the bayonet slots. If one so desires, he may change the combination of his own lock by taking out the tumblers from their seats within the heads *D* and transposing them from one position to another Of course in such a case a new key would be required so as to depress the tumblers to the proper degree The inventor of this improved padlock is Mr Raffaele Feola, 40 Stuyvesant Street, New York city

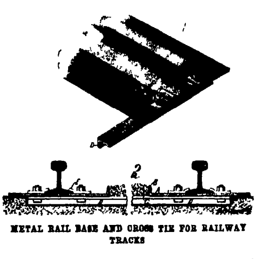


PADLOCK WITH INCASED BOLT

◆

METAL RAIL BASE AND CROSS TIE FOR RAILWAY TRACKS.

Time was when railroad tracks consisted of wooden rails faced with a strip of sheet metal Such construction seems absurd to us now No doubt the time will come when our present track construction in which the rails are secured to wooden ties will seem as absurd The objections to wooden ties are many and have so often been referred to in these columns that it is not necessary to enumerate them now A substitute for the wooden tie construction is illustrated in the accompanying engraving The rails are laid on metal base plates indicated at *A* Each base plate is provided with a flange along its inner edge which is denoted by the letter *B* It will be observed that these base plates extend longitudinally under the rails and form a continuous support for them At frequent intervals the base plates are connected by means of cross ties *C* which are also provided with a flange along one edge This flange extends downward as indicated at *D* and is imbedded in the ballast of the roadbed so as to provide an anchor for the tie The rails are secured to the base plates and ties by means of clamps *E* which are fastened in place with bolts The upturned flanges *B* of the base plates afford abutments against which the ballast is packed Thus they guard against lateral movement or distortion of the track while the flanges *D* of the ties prevent longitudinal movement or creeping The flanges *D* also serve as guard rails to catch and retain the wheels of a derailed train or car The base plate provides a smooth surface for the derailed car obviating injury or shock which results from a car bumping over the ordinary ties The continuous bearing for the rails provided by the base plates prevents low joints with the resultant hammering which soon wears out the track Messrs Murray A Temple and Harry C Temple of Berlin Heights Ohio have just secured a patent on this tie construction



METAL RAIL BASE AND CROSS TIE FOR RAILWAY TRACKS

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

AIR DRIER FOR STATIC ELECTRIC MACHINES. M R FARRAR, Greensboro, N C. This drier for such static machines as the Holtz or Wimshurst type is designed with a special reference for this use and combined with the machine as an integral part thereof, whereby the moisture is eliminated from the air within the casing by condensation and congelation on a refrigerating receptacle over which the body of air from the casing is continuously circulated in an endless cycle by means of a fan

Of Interest to Farmers.

AUTOMATIC COTTON TRAMPER.—R. H CAMPBELL Blooming Grove Texas The aim in this invention is to produce a tramper having means for controlling the feeding of the lint through the same so that when the compressing plunger is in its withdrawn position the feeding operation proceeds, but when the plunger is advancing the feeding operation ceases

TRACK-CLEARER FOR MOWERS — G BRAUN Duncan Neb The improvement has in view a device which will effectually throw the grass as it is cut from the standing grass completely within the swath cut by the mower and have a space on the outer side of the swath clear of cut grass in which the horse can walk and follow in the succeeding cut.

PEANUT PICKER AND STEMMER.—J T BENTHALL Suffolk Va In this device the vines are fed into a hopper are seized by disk fingers and become partially wedged in the throats between the fingers and the teeth The portion wedged the tightest will draw the vine through the other throats stripping the nuts and passing the vine to the next pair of disks. The nuts and leaves fall on a screen the leaves and vine being blown out while the nuts pass to the stemming device which removes the stems and the nuts then pass into a conveyer the trash being blown away

Of General Interest.

FLOAT FOR LOGS W I PIERPONT, JR Savannah Ga In operation the fastening pin or spike may be driven into the log or timber and the buoy body be then secured upon the pin and when the log has reached its destination the float including its fastening pin may be withdrawn from the log thus avoiding the use of any nails or other metallic fastening which may be broken off in the logs and injure saws or other tools used in working the logs

SYSTEM FOR MINE VENTILATION.—D BELLONI Edri Ia Mr Belloni's invention relates to improvements in means for ventilating mines. It is especially applicable to the ventilation of coal mines in which noxious gases are liable to accumulate but it is also applicable to any mine in which the removal of foul air is desirable

COMPOSITION OF MATTER.—C A GOLDSMITH York Pa The invention is a composition of matter designed for use in the treatment of smoking tobacco, and tobacco for use in making cigars and the object is to provide a liquid for treating the tobacco for removing therefrom the musty odor and cellar smells and other foreign odors sometimes found in tobacco.

BOX P H KRAETSCH Astoria Ore The object of the invention is to provide a box provided with a plurality of compartments, for containing postcards each of the compartments being independently removable from the box The cards may be inspected without removing them from the tray a notch permitting the lowermost card to be lifted from the bottom of the tray

SIPHON.—S I GRAHAM and A F FOWLER Trout Lake British Columbia Canada The discharge leg of the siphon is provided with a valve such as to prevent the suction of air into the leg through its discharge end but permits the passage of a fluid in the opposite direction and an air pump having a connection with the siphon for exhausting the air therefrom In connection with the siphon is a vent opening having a manually-operated valve by which the flow of the liquid may be easily controlled

WINDOW I CHEVRORAD Omaha Neb By releasing a locking pin either of the window sashes may be rotated in its groove whereby to open the top or bottom of the window or to reverse the position of the sashes In assembling the window the casement being in position the front or upper sash is put in place and the parting strip is inserted and the lower sash is put in place The inside rim is then placed in position and the annular ring or stop is secured in place by screws

DOOR HANGER G L SCHNEPF New York N Y The invention is an improvement in door hangers and tracks for sliding doors primarily such as include free and lineally movable roller bearings between the track and hanger and has in view a hanger and track by which the door may have an increased travel over doors supported on tracks and hangers of the same working length as hitherto constructed

ROLLER H R DERBY Jerseyville Ill The roller is suitable for pulverizing and smoothing the ground, the pulverizing taking place when the roller is moved one direction and smoothing when moved in the opposite direction. These two operations are performed by a single roller constructed with a series of disks independently revoluble, each disk having an approximately central rib with teeth projecting from each face of the rib, having radial or pulverizing faces at one side and rounded or inclined smoothing faces at the opposite side.

MOLD FOR MAKING FLUTED COLUMNS.—J P ARCHDEACON, Boston, Mass. The inventor provides a mold for making fluted columns of cement, plaster or other plastic material, the mold being arranged to permit of building the column at the intended place on a building or in a shop and giving it the desired tapering form and producing the flutes on the exterior surface with gradually less depth and width according to the taper of the column

LOCK FOR TOY BANKS.—C HANSEN, San Antonio, Texas. The invention relates to toy banks, and has for its object to provide a bank with a door to which is secured a receptacle which is adapted to contain camphor menthol, or other similar substance which will gradually decrease in size when exposed to the air there being a supported bolt on which there is a plate which is adapted to press against the contents of the box and means provide for a pawl to slip off a bar when the door will be found to be unlocked

FOLDABLE DISPLAY TRAY FOR MERCHANDISE.—F R FAULK and T BEATT Allegheny Pa The purpose here is to provide a construction used for exposure of seed packages or other merchandise in a prominent manner and that adapt the trays for close assembling in a suitable receptacle when the trays are not in use or are to be shipped to different localities where the goods held in the trays are to be exposed for sale

Household Utilities.

FIRE LIGHTING DEVICE.—J FRAO Bellingham Wash The object here is to provide details of construction for a fire lighter which is controlled by the ordinary alarm mechanism of a portable alarm clock, and that will ignite fuel in the fire pot of a stove or range when the alarm is put in motion at the instant of time for which it was set.

Machines and Mechanical Devices.

COMPUTER C A PITKIN Montpelier, Vt The invention relates more particularly to that type of computer in which there are provided two relatively movable members, one of which carries a series of multipliers and the other of which carries a series of multiplicands and for each of the latter a series of products resulting from the use of each of the several multipliers

EXHIBITING DEVICE.—E W LIVERMORE, Bellingham, Wash The object of this invention is to produce a device which is especially adapted for use in exhibiting fishes. The construction is such that the mounted fish will be presented to view within a glass jar and under water so that they resemble closely their natural appearance in life

Prime Movers and Their Accessories.

ELASTIC FLUID TURBINE.—J P NIKONOW Evansville Ind The invention relates to turbines of the general kind used in connection with elastic fluids such as steam compressed air or gases of combustion the more particular purpose being to produce a device of this type having its parts so shaped and arranged as to be easily assembled, and in its complete form offering particular advantages as to replacement and interchangeability of parts.

Railways and Their Accessories.

RAILROAD TIE.—F A BUELL Norfolk Va The invention is an improvement particularly in metal ties. It provides a construction whereby rails may be securely held from spreading and will be cushioned, and the cushion will have its elasticity entirely confined within the tie and the rail can rise and fall without displacing the tie thus permitting the rebound of the track without loosening the tie in its ballast or other seat

RAILROAD-TRACK F A BUELL, Norfolk Va The invention is an improvement in railroad tracks, particularly in the ties and the cushioning and fastening devices. The cushioning block of wood is confined in a recess and a metal cap which confines the cushion in the recess projects into the recess so that no portion of the cushion block is exposed and the elasticity of the block wholly available or fully utilized

Pertaining to Vehicles.

WINDSHIELD.—J R SPRAGUE, Norwalk Ohio The invention more particularly relates to improvements in the frame which supports the transparent section One object is to provide improved means for connecting the lower portion of the frame with the dashboard or filler-board interposed between the wind shield and dashboard

NOTE Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper

NEW BOOKS, ETC.

FACTORY ORGANIZATION AND COSTS. By J Lee Nicholson. New York Kohl Technical Publishing Company, 1909. Quarto, 410 pp. Price, $12.50.

This work is intended primarily as a handbook for manufacturers who are interested in modern methods of organization in systems of accounting, as a book of reference, and also as a text-book on cost accountings for the student It requires a fully qualified accountant—be he private or certified—or a business engineer to deal with this most important subject The author has a splendid grasp of the theory and technique of cost accounting Critical examination of this book shows that not a single germane item of any description has been neglected or slighted in any way The forms are given on a good scale, making it easy to compile forms adapted to the individual needs of the cost specialist The book is beautifully gotten up and is a credit to both author and publisher. There are also chapters relating to office appliances, which are very full If large concerns were aware of the savings that could be effected with the use of this machinery, they would not hesitate an hour to put in the necessary equipment Many a firm has gone to the wall for the lack of statistics which an adding machine would have helped to turn out in a few days. One section of the book which strikes us as being particularly valuable is the distribution of indirect expenses, which is the bugbear of any one who attempts to analyze accounts.

EFFECTIVE MAGAZINE ADVERTISING 508 Essays, About 111 Advertisements. Edited, with an Introduction to the Science of Advertising Copy, by Francis Bellamy New York Mitchell Kennerley, 1909 Large 8vo, 361 pages Price, $5

A couple of years ago Everybody's Magazine offered a series of prizes, ten in number, of $25 each, for the ten best essays in answer to the pertinent question Which is the most effective advertisement in this November issue of Everybody's Magazine?—and why?" The aim of this offer was to gain information which would be of value to the science of advertising in general and to the art of magazine advertising copy in particular The people who are influenced by advertising are the only criterions of effective copy The mere subjective theory on the part of the copy artificer is valueless, unless proved by the effect on the magazine reading public In other words, the advertisements were 'tried on the dog' and the 'dog" responded in the 500 essays which are herewith presented which were in turn selected out of some 900 essays. This book is a clarification of the advertising pages in the issue The selected advertisements are well printed, and are accompanied by excellent essays written by individuals. It is remarkable to see what a hold advertising has on the American people, and it is little wonder that advertisers continue to spend their millions in periodical publicity when they can see that their efforts are appreciated by such a highly intelligent audience of readers and buyers The book is a very novel one, and we can heartily commend it to all who are interested in any way in buying or selling advertising space

HANDBUCH FÜR HEER UND FLOTTE. Enzyklopädie der Kriegswissenschaften und verwandter Gebiete. Herausgegeben von Georg von Alten, Generalleutnant z. D Vollständig in 108 Lieferungen reichillustrierten Textes mit farbigen Beilagen Karten, Plänen, Gefechtsskizzen etc. Deutsches Verlagshaus Bong & Co., 1909

The last four installments of this handbook are primarily distinguished by the insertion of longer essays, which discuss the handling of troops. The essays are to be found under the headings *Angriff* (attack), *Angriff und Verteidigung* (attack and defense), and *Armeereserve* (army reserve) The author of these essays is a military instructor of repute, and evidently an authority Many authors of note have covered important topics. Count von Beck an Austrian general of infantry has prepared an excellent biography of Archduke Albrecht of Austria and has interestingly traced the career of this officer The stirring events of 1866 are tactfully and yet ably discussed General von Verdy du Vernois outlines the generalship of Alexander the Great. The articles on 'Algeria "Tunis," "Arabia," and "Argentine Republic" ably discuss the military geography and military history of these foreign countries. The importance of the age of men, animals, and warships in their relation to military science is well brought out. Among the novel articles that deserve mention are those on "Amsterdam,' "Anchor" Antwerp." Under "Armament an excellent discussion of the army and of warships will be found

THE LIFE OF A FOSSIL HUNTER. By Charles H Sternberg New York: Henry Holt & Co, 1909 12mo., 286 pages. Price, $1 60 net

This is one of the "American Nature Series." This is a new and attractive series, the first volumes of which have already been published. The author is the oldest and best known of the explorers in the palæontological field, and he has contributed some of the finest specimens from Kansas, Texas, Oregon, and other places, which adorn the museums of America and Europe. It is a most interesting Monograph, bubbling full of adventure and representing a life of self-sacrifice worthy of record and recognition by all lovers of nature. It is handsomely bound and printed.

THE BIOGRAPHY OF A SILVER FOX. By Ernest Thompson Seton With 100 illustrations by the author New York. The Century Company, 1909.

Although Mr Thompson Seton has been branded by a faunal naturalist now in foreign parts as a "nature fakir," it cannot be denied that he writes with sincerity and with charm. This little story of "the monogamy of the better class fox," to quote the author's words, may be regarded as a graceful narrative of animal life, the kind of narrative that has made Mr Seton deservedly famous.

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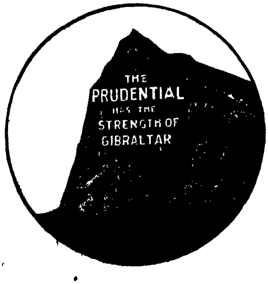

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PATENTS FOR SALE

FOR SALE U S and Canadian patent No. 912,191. Adjustable standard and improved holster for wagons. A leader. Manufacturers and wagon companies address C M Shotwell Box 422, Kemmerer Wyoming.

Inquiry No. 8868.—Wanted to buy nickeloid for buttons.

FOR SALE.—Patent No 917,391 Rotary engine, compound expansion continuous drive reversible, cheap to manufacture other advantages. For full particulars address Patentee, 3 Durocher St., Montreal Canada.

Inquiry No. 8901. Wanted to buy new or second hand machinery for making "bow type" mouse and rat trap springs and wire parts single machine or full outfit.

FOR SALE

FOR SALE.—Specialty for manufacturers. Dental floss holder patented May 1909. For further particulars apply direct to inventor T A Tubbs Seattle Wash. care H S Emerson Company.

Inquiry No. 8908. For a dealer in tapes and cords for Venetian blinds.

PARTNERS WANTED

CAPITALIST OR PARTNER WANTED by the inventor of patent leak stopper for ocean ships. The object is to secure capital to pay for foreign patents. A grand opportunity. Address O F Box 773, New York.

Inquiry No. 8918. For manufacturers of "Wydt's Electro-Catalytic Sparking Plug."

HELP WANTED

MECHANICAL ENGINEER wanted for charge of designing and drafting office for large engineering works. Give experience. Address Canada Foundry Company Ltd 212 King St West Toronto Canada.

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ENAMEL PREPARATION for certain conditions for utilization on steel iron. Must be as represented. Send correspondence and samples prepaid to William R. Reinick, 1217 Chestnut Street Philadelphia, Pa.

Inquiry No. 8921. For the manufacturers of gilt paper.

WANTED. Customer heavy oak and Southern pine shavings. The Wm. J Oliver Mfg Co Knoxville, Tenn.

Inquiry No. 8922.—Wanted the address of Worthington Boiler Co.

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Inquiry No. 8938.—Wanted machinery used to spin or wrap paper pencils in the manner that paper pencils are made.

A LIST OF 1,500 mining and consulting engineers on cards. A very valuable list for circularizing, etc. Price $15.00. Address Munn & Co. List Department. Box 773, New York.

Inquiry No. 8941. For manufacturers of machinery for making fly screens.

Inquiry No. 8957. Wanted manufacturers of angle bars either malleable steel or sheared.

Inquiry No. 8960. For the address of the Windsor Mfg Co. manufacturers of waterproof collars and cuffs.

Inquiry No. 8966. Wanted the address of the Cubendet Motor Co.

Inquiry No. 8969.—Wanted machines that make accordion dress plaiting (steam).

Inquiry No. 8973. Wanted to buy complete outfit for making meat hooks.

Inquiry No. 8974. For address of firms interested in fishing reels.

Inquiry No. 8975.—Wanted the address of the builders of moving stair cases.

Inquiry No. 8977. For manufacturers of machinery for manufacturing denatured alcohol.

Inquiry No. 8978. Wanted the address of manufacturers of dry pans or crushers to grind sand for plastering and cement works.

Inquiry No. 8980. For the address of manufacturers of mortars and pestles that are used by druggists.

Inquiry No. 8982. Wanted a machine or process for slitting or laminating the edges of heavy cardboard impregnating the slit or laminated edge with a waterproof material and compressing the edge after treatment. The object of the process is to produce an edge that shall be waterproof and which shall not fray or split when in use.

Inquiry No. 8984. Wanted the address of the manufacturers of Cypress wash tubs.

Inquiry No. 8986.—Wanted to buy crown and flint glasses for telescope objectives.

Inquiry No. 8987. Wanted the manufacturers of the Van Winkle Wood Vises, and the Weber power motors.

Inquiry No. 8989. Wanted a machine for making cocoa fiber mats.

Inquiry No. 8990. For information regarding shoes not made of leather but similar to the same and are as durable.

Inquiry No. 8991.—Wanted to communicate with manufacturers of large straw hats for every-day wear.

Inquiry No. 8993. Wanted to buy producer gas plants.

Inquiry No. 8994. For manufacturers of an apparatus to produce very high temperatures.

Inquiry No. 8995. *Wanted to buy round and oval glass paper weights, such as are used for mounting photographs.*

Inquiry No. 8996. Wanted addresses of manufacturers of machinery for working orange wood manicure sticks.

Inquiry No. 8997. Wanted the address of the manufacturers of bread or cake boxes.

Inquiry No. 8998. Wanted an automatic snap, ball and socket or other device which can be used easily and securely to fasten together the edges of small wooden boxes.

Inquiry No. 8999. For manufacturers of combined clothes and clothes pin receptacle.

Inquiry No. 9000. Wanted a combined appliance for holding hats, coats and umbrellas safely and securely.

Can, C B. Bertels	[illegible]
Can marking device T O Matthews	926,371
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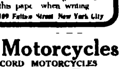

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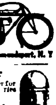

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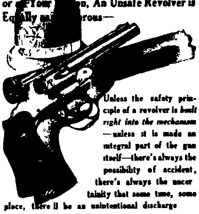

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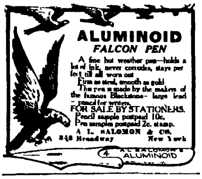

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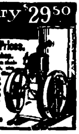

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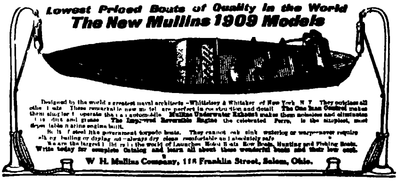

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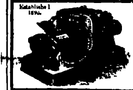

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SCIENTIFIC AMERICAN

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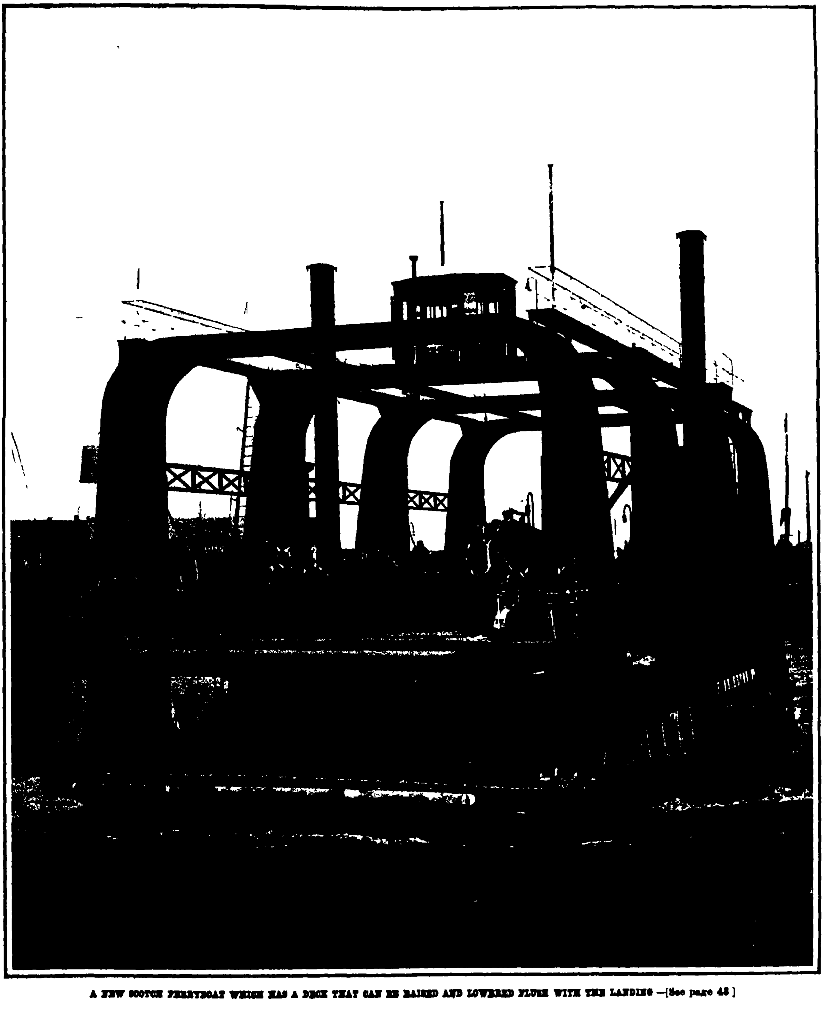

A NEW SCOTCH FERRYBOAT WHICH HAS A DECK THAT CAN BE RAISED AND LOWERED FLUSH WITH THE LANDING.—[See page 43.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles short and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

LONGER DAYLIGHT.

There are a great many things to be said in favor of and a few against the proposal to advance the clock by one hour during the summer months. Although the suggested change is startling there is in it nothing of the ludicrous or farcical as some of its critics have suggested. The principal object of the movement is to apportion a larger part of the period of daylight to evening rest and recreation than is now possible in latitudes embraced by the United States. Under present conditions the close of the working day is so near sunset that by the time the evening meal is over twilight has commenced and the stretch of remaining daylight is too short for any lengthy outdoor sports or pastimes of the kind which require daylight for their exercise.

Those of us who have spent part of the summer months in northern latitudes where the later sunset and longer duration of twilight combine to make the summer evenings the most lengthy and delightful period of recreation understand perfectly well the motive and force of the arguments which have led to the present widespread movement in favor of what has popularly come to be known as a longer daylight day. The evening is the ideal time for outdoor recreation. The mind and body are relieved of the stress of the day's occupation and the cooler temperature which is a consideration even in the northern latitudes becomes of double importance in the more southerly regions where temperatures during the day run up to 90 or even 100 in the shade.

The proposed arrangement as advocated by the National Daylight Association in this country is that from and after 2 o'clock in the morning of the first day of May in each year until 2 o'clock on the morning of the first day of October the standard time shall be one hour in advance of the standard time now in use. This result is to be secured by advancing the hands of the clock one hour on May 1st and moving them back one hour on October 1st. The change would involve a shortening of the hours of sleep only on the last day of April. Subsequently through the summer months people would get up and retire by the clock as usual and the regular schedule of railroads factories and all social institutions would be maintained as before. The only perceptible difference would be that instead of the twilight ending at from 9 to 9 30 it would last from 10 to 10 30 according to the latitude and the public would have the benefit of two or three hours of daylight after the evening meal instead of one or two hours as under the present arrangement.

We cannot quite agree with the circular of the Daylight Association that no adjustment of railroad schedules would be necessary. Some adjustment would obviously be needed on the two days which marked the opening and close of the longer daylight season but with those two exceptions regular schedules could be maintained without interruption during the 150 days or more of the late spring summer and early fall months.

At the present time there is a bill before the British Parliament which provides for a change similar to that related above. That the matter is being seriously regarded in that country is shown by the fact that it has the indorsement of the Education Committee of the London County Council of over one hundred municipal corporations and town councils of the National Convention of Royal Burghs of Scotland representing about two hundred towns and of one hundred and thirty chambers of commerce associations and clubs. A similar bill is now before the Canadian Parliament and the report of the special committee to whom it was referred says that in view of the almost unanimous support in favor of the bill and that its object can be so easily attained, they consider that it should be put in force as soon as possible. It is probable that a similar bill which has already received wide journalistic indorsement will be introduced in France.

SUBURBAN TRAFFIC IN LONDON AND NEW YORK.

Geographically considered the ideal conditions for the rapid inflow and outflow of the population of a great city to and from its business center are that the city shall be located inland and that the traffic movement shall not be obstructed by any natural topographical features such as are presented by the sea or wide and deep rivers or estuaries. Judged by this standard London Paris and Berlin are admirably located whereas New York is at a great disadvantage. In a diagram accompanying the last report of the London Traffic Branch of the Board of Trade the density of railway traffic and its distribution on the various suburban railways are very lucidly shown. The diagram was drawn from statistics of the railroad companies of the number of passengers who entered the business center of London in the month of October 1907 from all stations within thirty miles of the city. It includes the number of trips taken to the city by the season ticket holders. The figures show that of the 9 743 669 persons who entered within a four mile radius of Charing Cross by railway in this month 8 071 78[illegible] or about 83 per cent came from localities not exceeding ten miles from Charing Cross 8 5 per cent entered from distances between ten and twelve miles and less than 8 5 per cent from distances lying between twelve and thirty miles from Charing Cross.

An analysis of the table shows that 2 232 201 passengers came from the first zone which is from four to six miles distant from Charing Cross and that they averaged 35 [illegible]84 passengers to the square mile that 3 406 588 passengers came from the six to eight mile zone and that the average was 38 7[illegible]9 passengers per square mile that 2 43[illegible] 996 came from the eight to ten mile zone and averaged 21 [illegible]12 passengers to the square mile. From the ten to twelve mile zone the travel consisted of 843 780 passengers who averaged 6 104 to the square mile 331 [illegible]13 averaging [illegible]92 to the square mile came from the fifteen to twenty mile zone and 107 614 averaging 124 to the square mile came from the twenty five to thirty mile zone.

Turning now to the traffic problem in New York city we find that before the period of big bridges and tunnels Manhattan Island was most unfavorably situated for the rapid and comfortable handling of daily passenger traffic. Shut off on one side by the sea and on two others by broad and deep rivers the city was denied those advantages accruing to large metropolitan cities in Europe from an inland situation which permit of the laying out of lines of railroad travel in every direction. When the railroads radiate from the business center of a city as the spokes from the hub of a wheel the congestion of traffic decreases theoretically as the square of the distance from the center. The figures quoted above for London show how quickly the outgoing crowds at night are disembarked from the trains over one half of the total of nine millions having left the cars by the time they have passed some six miles beyond the central zone. In Manhattan however before the era of bridges and tunnels the greater part of the rush hour travel moved in parallel lines up and down a long and narrow island and many miles had to be covered before any relief was noticeable. The intolerable congestion due to these conditions hastened the construction of the subway which was completed only just in time to save the transportation problem in New York from an absolute deadlock. With the approaching completion of all of the eleven tunnels and three great bridges which have been built during the last decade and a half to connect Manhattan Island with New Jersey and Long Island New York city will be favored with the diverging system of transportation which characterizes London and other great cities of Europe. The splendid facilities for comfortable and rapid travel to the vast suburban areas lying to the east and west of Manhattan are certain to act with a loosening up effect upon the present congestion of our elevated and subway lines of travel in Manhattan. It will need only the construction of the Fourth Avenue line in Brooklyn with a tunnel beneath the Narrows to Staten Island to place New York city in practically as favorable a position for all round radial travel as London itself.

INCONCLUSIVE TESTS OF THE SCOUT CRUISERS.

The possession by the United States navy of three scout cruisers the Birmingham "Chester and Salem absolutely identical in size and model but driven by three different types of engine presents an unrivaled opportunity for determining the relative all-round efficiency of the three types for naval purposes. We are free to confess however that the tests which have already been carried out elaborate and costly though they have been, do not seem to be conclusive. In fact the further the tests have gone the more bewildering do the results obtained appear.

It is absolutely necessary, if the data secured in such trials are to be of value that the conditions in the case of the three competitors shall be absolutely identical. It was the intention of the Navy Department that they should be so, but unfortunately, with the exception of the government standardization trials at Rockland and the water-consumption trials made early in the year, there were certain disturbing elements, some accidental and others incidental to the conditions under which the tests were made and quite unavoidable which so greatly vitiated the results that they have lost their value.

Such facts as have been clearly established are a verification as far as the relative merits of reciprocating and turbine marine engines are concerned of previous results obtained with the two types. At the lower speeds or what are known in the navy as cruising speeds the reciprocating engines of the Birmingham proved to be more economical but at the higher speeds and notably when the ships were driven under full power both the Parsons and the Curtis turbines showed a marked superiority in coal consumption, and drove their respective vessels at considerably higher maximum speeds. As far as the published official figures show there is not much to choose between the two types of turbine sometimes one and sometimes the other showing a slight advantage in both the standardization and in the water-consumption trials.

It is when we come to the long-distance trials at sea that the confusion begins. In the coal-consumption tests which were carried out a few months ago at the rate of 15 knots an hour the Birmingham showed a coal consumption of seventy-one tons the Chester" of eighty five tons and the Salem of one hundred and seven tons a day. The disparity between the consumption of the Birmingham and the Chester was not unexpected but the consumption of the Salem was inexplicable. At the conclusion of the trials the Salem returned to the builders yard and on opening the casing it was found that a loose bolt which had probably fallen by accident into the casing had bent over the edges of a large part of the blading thereby obstructing the passage of the steam and running up the coal consumption.

Shortly after the conclusion of the trials the Chester and the Birmingham sailed for Liberia on the coast of Africa and after repairs had been made on the Salem she was dispatched to join the other two ships. On the return trip the three scouts starting from Madeira steamed side by side for five consecutive days across the Atlantic. All three were careful to maintain the same speed and everything was done to render this a fair five-day trial of the engines. There was no attempt made to run at high speed and the average rate per hour for the five days was 13 8 knots. The test has furnished the latest bewildering coal-consumption figures of the many which have been obtained with these vessels for the results of the first sea trials have now been completely reversed the Salem having burned an average of ninety five tons per day the Birmingham one hundred and ten tons and the Chester one hundred and thirty tons per day. The explanation of the reversal of form on the Birmingham and Chester given by the officers of these ships is that while they were anchored off the coast of Liberia the bottoms of the ships became as they always will do in tropical waters very foul. On the other hand it was explained by the officers of the Salem that while they were lying in the mud at the Quincy yard for repairs they were at a similar disadvantage.

Now in the face of the above figures it seems that something must have gone wrong with the Chester's turbines a fact which will no doubt be determined as soon as she can get to a repair yard but the moral of these very bewildering results is that in view of the enormous importance of the turbine question the Navy Department should undertake a fresh series of trials of these three ships in which every care should be taken to render the conditions identical. Moreover the trials should be of such a length and be carried on under such varying conditions, as to settle beyond all question of doubt which is the best type of drive to install in the future warships of the United States navy. We do not hesitate to affirm that this is to-day the most important question affecting the physical characteristics of the ships of our navy. Of the reliability of the turbine, whether it be the Parsons or Curtis type there is no doubt whatever and it is because of its reliability when driven for long periods of time at full power that it is vastly superior to the reciprocating engine for naval purposes. The question between the two types of turbine however is one of coal consumption and the question of coal consumption is intimately related to the question of radius of action, or total steaming distance, one of the most important elements in a warship. When two similar cruisers cross the Atlantic with a difference in coal consumption of over [illegible] per cent, it is clear that the demand for further examination into the range of efficiency of their turbines is well made.

ENGINEERING.

According to statistics furnished by the United States Forest Service, the art of wood preservation in this country during the year 1908 called for the use of 56,000,000 gallons of creosote, 19,000,000 pounds of zinc chloride, with small quantities of corrosive sublimate, crude oil, and other chemicals. Of the creosote, nearly seven-tenths was imported, most of it from England and Germany

The longest pipe line in the world is that which extends from the Oklahoma oil wells to New York harbor. At the present time the oil field of Oklahoma is the most active in the United States. It is not likely that the line will be put to immediate use for conveying oil over the whole distance. The completion of the system is regarded rather as a provision for emergency, and to meet the future conditions, when the Pennsylvania and West Virginia fields shall have been depleted.

The final dimensions of the great drydock which the United States navy is building at Pearl Harbor, in the Hawaiian Islands, show that the government is wisely building for the future. The dock will be 1,152 feet long from the coping to the outer sill, 140 feet wide at the top, and will have 35 feet of water over the entrance sill at mean high-water level There will be a sill at the middle of the dock, for an intermediate caisson which will divide it into two docks, 575 feet and 532 feet long respectively

On July 6th the United States Reclamation Service announced that the headings had met in the great Gunnison tunnel, which the government is building in western Colorado to carry the water of the Gunnison River into the Uncompahgre Valley, where it will be used for irrigation The tunnel, which will be cement lined throughout and will have a finished cross section of 10½ by 11½ feet, will be the largest underground waterway in the world It is six miles in length, and will carry thirteen hundred cubic feet of water per second Its cost will be over $2,500 000

On July 19th the twin tunnels extending beneath the Hudson River from the Pennsylvania Terminal Station in Jersey City to the Hudson Terminal Building in Manhattan, at Cortlandt Street, will be opened for operation Trains will run from a five-track station, eighty feet below the Pennsylvania Terminal, to a five-track loop station beneath the Terminal Building As soon as sufficient cars can be obtained from the builders, the twin tunnel, running parallel with the Hudson shore line on the Jersey side, and extending from the Pennsylvania to the Lackawanna terminals, will be also placed in operation

From every point of view the round-the-world cruise of the battleship fleet was a pronounced success, and the crowning indorsement of all has been the recent announcement of the Assistant Secretary of the Navy that the repairs to thirteen of the sixteen battleships that made the voyage have been completed at a total cost to the Engineering and the Equipment bureaus of $50,280, or less than $4,000 per ship Many were the predictions of trouble, damage, and even disaster, at the time of the starting of the fleet, but not one has been fulfilled On the contrary, the benefit to the navy in the increase of its physical efficiency and the improvement of its *morale* has been invaluable.

A test was recently made in England of a steam engine designed to work at pressures of as high as one thousand pounds per square inch. According to our contemporary, Engineering, the tests showed a steam economy of 13 5 pounds per brake horse-power per hour The engine is of the inverted V type, with eight cylinders, the high pressure two inches, low-pressure five inches in diameter, each pair being arranged in tandem on two cranks. The stroke is four inches, the speed, eight hundred revolutions per minute Forced lubrication is used, the oil being pumped into the steam on its way to the cylinders In the test the steam pressure was five hundred pounds, temperature 720 degrees, the revolutions seven hundred per minute, and the brake horse power developed 32.65

With a view to enabling marine turbine engine propellers to work at higher efficiency, Mr Yasuzo Wadagaki, in a paper before the Northeast Coast Institution of Engineers and Shipbuilders, proposes to use a metallic casing surrounding the screw propeller, the forward and aft ends of which are flared into bell-mouth shape, with a cross-sectional area gradually contracting from the two ends toward the screw propeller. By this arrangement the forward velocity of the water, which is imparted by the frictional pull of the ship's side, is accelerated, until at the most contracted part of the channel, where the water is acted upon by the screw propeller, the velocity rises to a maximum, the propeller operating "in water having a relative velocity much higher than the forward speed of the vessel." By this device Mr. Wadagaki believes the slip will be reduced and the screw propeller efficiency proportionately increased.

ELECTRICITY.

In a recent lecture before the Royal Institute, London, Prof. W. E. Dalby showed that for long distance traction at speeds under 55 miles per hour steam is much more economical than electric drive. Electricity possesses an advantage for high speed travel because the power is limited only by the number of axles to which motors may be applied

The largest electrically-controlled switch tower in the world has just been put into service at Providence, R I, on the New York, New Haven & Hartford Railroad The tower is equipped with 77 switch levers, providing 266 combinations. Elaborate precautions are furnished to prevent the giving of a wrong signal The power used is taken from the feed wires of the railway, but as a precaution two other sources of power are provided, which may be drawn upon in case of emergency

The old-style gasoline lights which have been used in Central Park are to be displaced with 1 400 or more than twice as many electric lamps. A very artistic lamp post has been designed for the new lamps. One of the objections to the gasoline lamps was the fact that the leakage of the oil ruined the grass around these lamp posts Furthermore the lamplighters did much damage by making short cuts through the flower beds along their routes from one lamp to another

From time to time we hear of some enterprising amateur driving an electric generator by means of a windmill, and thus obtaining electricity without cost except that of the installation and with it lighting his house and operating various household machinery Recently a German company has gotten up a special electric generator equipment adapted to be operated by wind power The installation comprises a dynamo and a storage battery, the latter serving to store the excess power until such time as it is required The apparatus is entirely automatic, and requires absolutely no attention except in time of storm, when it is necessary to reduce the sail area of the wind wheel A special regulator used with this apparatus automatically keeps a constant pressure on the lighting circuit this being entirely independent of the number of revolutions of the dynamo or the condition of the storage battery

One of the large new steamers of the Orient Steam Navigation Company plying between England and Australia has been provided with a model electric equipment even including an electric laundry The wash is first boiled in a tank, where the water is kept at boiling point by means of steam pipes, thence it is carried to a pair of washing machines driven by an electric motor The clothing is dried by means of a hydro-extractor driven at 640 revolutions per minute by a 2 horse-power motor There is a Decoudon machine driven by an electric motor, which is provided with a safety device to prevent the operator's fingers from being caught under the rollers If the fingers come too near the roller, the motor which drives the machine is automatically stopped The laundry is equipped with an electrically-driven ironing machine and with several electric irons

Many hospitals in England are provided with a special apparatus for extracting iron and steel fragments from the eye by means of powerful electro magnets. The magnet employed has a core three feet long and six inches in diameter of the best Swedish soft iron Two hundred pounds of insulated wire are wound in two coils about the core The end of the magnet is threaded to receive terminals of different shapes to suit various conditions. The magnet is mounted on ball bearings and can be moved in any direction The strength of the magnetic field may be varied at will by means of a rheostat. When used at its maximum power, the magnet exerts a pull of 30 pounds per square inch at a distance of an inch A special type of apparatus is provided for reclining patients. In this case the magnet is mounted on trunnions, and is tilted by means of suitable gearing operated by a hand crank

A new form of electrical vacuum meter has recently been devised It possesses a distinct advantage over other electric vacuum meters in the fact that it requires no instrument for measuring the current resistance or intensity The device consists of a glass tube which communicates with the vessel in which the vacuum is formed A wire passes through this tube, and forms part of a circuit through which a current of constant pressure is fed At the center of the tube a small weight is attached to the wire The current passing through the wire heats it to a certain degree, dependent upon the intensity of the current, and also upon the amount of heat carried off by the gas surrounding the wire As the gas is rarefied it dissipates less and less of the heat, causing the temperature of the wire to rise. The increased temperature expands the wire, making it sag. The glass tube is graduated so that the extent of the sag may be observed, and thus the degree of rarefaction is determined.

SCIENCE.

A new parasite which attacks the vine at the root was discussed at the Académie des Sciences by M Guignard chief of the College of Pharmacy It is designated clandestine," as it is quite invisible in general, so that it is all the more dangerous The parasite is believed to be a fungus of the phanerogam family Experiments upon it are being continued at the biological laboratory of Nantes

The New York Aquarium has acquired an octopus after considerable expense and difficulty The specimen was captured in Bermuda waters and conveyed to this city in a large tugboat which was specially chartered for the purpose During the forty-eight-hour trip from Bermuda to New York seamen were kept busy pumping water into the tank which contained the octopus

The Smithsonian Institution of Washington will erect on the very summit of Mount Whitney Cal (altitude 14 500 feet) an observatory which will enable investigators to study atmospheric conditions at great elevations in dry air and in clear skies The observatory will be erected from the Hodgkins fund and will comprise a three-room structure of stone substantial enough to stand for centuries

Dr Osler has stated that the question of preserving the teeth is more important than the liquor question No doubt much dyspepsia is due to decayed and defective teeth which preclude complete mastication of the food (even if anybody in America had the time to eat properly) Dentists like doctors are now beginning to realize that their true mission is not a general rebuilding system but a systematic and well-considered effort to prevent and overcome the decay and loosening of human teeth

A French microscopist has devised a method of detecting and recognizing traces of blood on knife blades and other opaque objects even when the stains cannot be seen with the naked eye. The light of a Welsbach burner is concentrated upon the part of the object under examination through a tube which is placed obliquely above the object glass and which carries an iris diaphragm a condensing lens and a total reflection prism A photographic camera may be substituted for the eyepiece

The freedom from corrosion and other properties of tantalum suggested the employment of this metal as a material for pens but tantalum pens have failed to pass the test for durability which is applied (in France) to steel pens This test consists in loading the pen with a weight of 180 grammes (6 1/3 ounces) and moving a band of paper beneath and in contact with a pen at the ordinary speed of writing until 10 kilometers (6¼ miles) of paper have passed The loss in weight of the pen should not exceed 0 7 milligramme (0 0108 grain) The tantalum pens were found to lose more than twice this amount but the loss has been reduced to 0 8 milligramme (0 0123 grain) by slightly oxidizing the tantalum

A recent issue of the Gazette Astronomique of Antwerp announces that the great telescope of the Paris exposition of 1900 with two objectives visual and photographic 47¼ inches aperture a coelostat mirror 6½ feet in diameter and various accessories the whole costing more than $150 000 to construct is offered for sale by the receiver of the exposition On this announcement Cosmos which had vainly endeavored to find out what had become of the monster telescope makes two comments first, that the receiver has not been unduly precipitous in converting the assets into cash, and secondly that here is an exceptional opportunity to procure an extraordinary instrument probably for less than one-tenth of its cost as there will be few purchasers for a telescope which requires for its housing a building more than 130 feet long

A bulletin recently issued by the United States Department of Agriculture sets forth the results of a long series of experiments carried on by Dr Benedict and Mr Carpenter with the remarkable respiration calorimeter at Wesleyan University which in the hands of Atwater and Benedict has added so much to our knowledge of metabolism As a result of these investigations it seems that the human body is a machine of such *wonderful efficiency* that *one fifth* of the energy expended by it can be utilized as work and that this efficiency is more or less the same in men of all types The longest and most thorough training does not change this ratio The professional athlete, if he is able to outstrip the novice does so not because he has better muscles but because he is able to put more energy in the shape of tissue change into action Training besides preparing the heart to stand great strain acts to increase the subject's power of using up his tissue and by giving him more muscle tissue to use rather than by teaching him to conserve his energies In other words the professional has a more powerful engine because he is able to use more fuel and not because he wastes less steam, if we may employ a mechanical simile

AN ENGLISH ELECTRICALLY OPERATED EVAPORATIVE CONDENSER PLANT

BY FRANK C PERKINS

The accompanying illustration shows the construction of an English evaporative condenser constructed to do for the atmospheric condenser what the Contraflo does for the ordinary wet-surface condenser utilizing compartmental drainage This plant was installed to deal with 60 000 pounds of exhaust steam per hour and to maintain a vacuum of 25 inches under severe conditions there being no available water except from the city main

It will be noted from the illustration that the condenser is formed of two sections of pipes supported by a base of brick and concrete forming an enormous tank Each of the two groups or sections is divided into smaller sections collectors being placed at the end of the coils for separately draining them in such a way as to separate the water from the vapor The water of condensation then flows into a seal box and an electric motor driven pump carries a larger part of it away directly to the hot well while still at a high temperature

Sectional drainage is regulated to suit the load on the condenser In order to obtain at the same time both a high vacuum and a hot feed Care was taken in the design of the installation to prevent all the water of condensation from being drained from the pipe for in order to obtain efficient condensation of steam the effervescent action is necessary Valves are arranged so as to provide the adjustment of the sectional drainage to synchronise with the load and to secure a hot feed on light load as well as on peak load

A slow speed electric motor is utilized for driving each of the two sets of three cylinder air pumps In the same pump room are located two direct connected electric motor-driven centrifugal pumps for circulating the water over the condenser pipe

A HUGE EVAPORATIVE CONDENSER

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A NEW ELECTRIC TRAVELING SCALE CRANE

BY WALTER BA EY

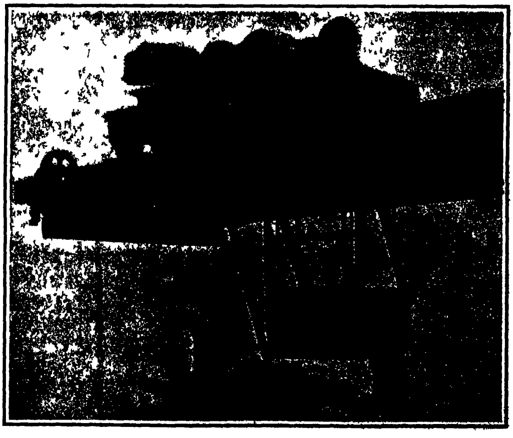
The accompanying illustration shows the construction and method of operation of a three motor electric traveling scale crane all movements of which are accomplished by electric power The scales are supported on a trolley truck frame and carry the hoisting mechanism on an independent steel framework while the scale beams are in the cage suspended from the trolley and readings are taken and recorded by the operator

It is of interest to note that the crane is provided with three beams two scale beams with several recording poises and one tare beam permitting the scale weights of several different items of material to be easily and accurately determined A movement of the hand lever transfers the load from the knife edges of the scale to the trolley truck frame when desired and the operation thereafter is the same as with an ordinary trolley

It will be seen that an open side platform is furnished for carrying long pieces such as bars and rods this platform being designed to suit the material to be handled The crane is adapted for weighing material when loading checking invoiced weights, and for loading for shipment as well as for inventory

The illustration shows a three-motor electric traveling scale crane fitted with alternating-current 3-phase 60-cycle 220-volt motor This construction is used in warehouses for handling freight, structural material, or any other class of goods of which the weight is desired The scale beams are so arranged that record of the weight of each piece can be made automatically

The scale mechanism can be thrown out of service and the carrying beam cast off so that the crane may be used as a standard traveling crane for general work



A NEW ELECTRIC TRAVELING SCALE CRANE.

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"Speaking" Dynamos and Transformers

The human voice is perfectly transmitted a considerable distance by undulatory or induction currents produced by periodic alterations in the magnetism of a magnet Prof W Peukert of Brunswick Germany has tried to magnetize an iron core by currents of the kind produced when a microphone is spoken into To this effect he inserted a coil surrounding a closed bundle of soft iron wires in the circuit of a microphone The sounds pronounced in front of the microphone caused the iron core to vibrate slightly thereby rendering conversation with perfect distinctness though so feebly that the ear had to be brought close to the iron core.

It is well known that the permanent magnetism of iron under certain conditions is markedly influenced by feeble, variable magnetizing forces. This suggested the idea of subjecting the iron simultaneously to a constant magnetizing force With this object in view the core was surrounded by a second coil of wire traversed by direct current. The iron core immediately began to give out intense sounds. In fact, by using a direct current of proper intensity, speech was so loudly reproduced as to be distinctly audible at a distance of several yards.

In another arrangement a coil and soft iron core were inserted between the poles of an electro magnet. Again a very intense and distinct reproduction of speech was produced The sound intensity in this case as well, depended mainly on the excitation of the electro magnet. A reproduction though of considerably less intensity, is also obtained when using a coil without iron core

These experiments having shown a considerable permanent magnetization to be the main factor, the substitution of a large steel magnet for the electro magnet was suggested. Accordingly a horse-shoe magnet, on a wound iron core, was used with excellent effect Speech was reproduced very distinctly By properly choosing the shape and dimensions of the various parts it thus was possible to obtain a novel telephone apparatus, remarkable for its simplicity and free from the disadvantages of vibrating plates or membranes. This telephone comprises a magnetic circuit as perfectly closed as possible whose ultimate particles partake in the oscillation insuring—because of the magnitude of the vibrating mass—a considerable sound intensity These effects can even be increased by using an acoustic funnel the whole system constituting an extremely simple loud-speaking telephone free from the upper harmonics that usually spoil the timbre

Similar experiments with equally satisfactory results were made on different alternating-current transformers Even a dynamo could be made to talk. The field magnets of the dynamo were excited from a special source of continuous current The microphone circuit being applied to the brushes the dynamo repeated with perfect distinctness the words pronounced in front of the microphone Speech and song were reproduced with equal clearness a small 500-watt shunt dynamo producing sounds distinctly heard throughout a hall of fair size

While large-sized machines show the same effect, the sound intensity of the reproduction by no means increases with the size of the machine, the microphone current undergoing no corresponding increase

It is doubtless an interesting physical phenomenon that the heavy iron masses used in connection with dynamos and transformers should be acted upon to such an extent by feeble microphone currents.

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The government commission appointed to regulate the Russian platinum industry has, in conjunction with representatives of that industry drawn up a scheme for the formation of a compulsory syndicate. In connection with this scheme, the exportation of unrefined platinum is to be prohibited, its production is to be regulated by law, and credit is to be allowed on platinum by the State Treasury until the export trade in that article to foreign countries shall have become more [illegible]

Wireless Telegraphy and Meteorology.

Dr. Polis, the director of the meteorological observatory at Aix la Chapelle, visited the United States in 1907 and, having become convinced in Washington of the reliability of regular wireless communication between vessels, instituted, in the course of his return voyage, experiments which demonstrated the feasibility of transmitting weather indications from ship to ship in this way. The coast wireless stations which are most important for communication with vessels navigating the Atlantic Ocean are those of the English Channel, the west coast of Ireland and the eastern shores of the United States and Canada. Several of these stations can make themselves understood to a distance of 2,000 miles, so that vessels can receive intelligence from land during the entire voyage across the Atlantic. The wireless transmitters on shipboard, however are much less powerful Their radius of action never exceeds 500 miles, and they cannot send messages directly to land from a greater distance than this.

During the summer of 1908 Dr Polis made an experimental voyage across the Atlantic and back, on the Hamburg steamer "Kaiserin Auguste Victoria." He had arranged with several steamship companies to take part in the experiments, and from their vessels he received 25 wireless messages on the outward and 19 on the return passage.

In addition, the Aix la Chapelle observatory sent him, *via* the wireless station at Clifden, Ireland, daily reports of meteorological observations made on the English and French coasts. The transmission was perfectly successful up to the end of the fourth day of the outward voyage, when the ship was about 2,000 miles from the Irish coast. The messages, which were in cipher, were transmitted without a single error

When the ship came within the zone of influence of the American stations, it received daily reports from the Weather Bureau at Washington These reports were transmitted more rapidly than those from Aix la Chapelle, but they were often curtailed, a fact which was attributed to the employment of code words instead of ciphers.

Conversely, meteorological observations made on the ship were sent out daily by wireless, for transmission to Aix la Chapelle. During the first two days of the westward voyage these messages were received directly by the wireless stations on the English Channel Afterward, the messages were transmitted indirectly through vessels nearer shore This system was employed until the ship was in mid-ocean and the transmission of the message to Aix occupied two full days. The messages sent directly on the return trip reached Aix in less than 13 hours—one of them in one hour and forty minutes

Daily weather charts were drawn from the reports received from land in combination with observations made on board. A German commission has since been appointed for the purpose of conducting a more extensive series of experiments.

Collaboration between meteorological and wireless stations, ashore and afloat, would benefit navigation as well as meteorology for the captain of a ship at sea has a profound interest in forthcoming weather changes. The receipt of various meteorological data from a few stations would not always suffice, but the void would be filled if the wireless stations on the coast should send out daily, at a predetermined hour, weather forecasts obtained from neighboring meteorological stations, for the benefit of all ships within the zones of influence of the wireless stations. In particular, effective warnings of approaching storms might be given in this way

An attempt in this direction has already been made in Holland. The police schooner of the North Sea fisheries receives daily, while within the zone of influence of the wireless station of Scheveningen, the weather forecasts of the meteorological institute at Bilt. Whenever it is possible, special storm warnings are also sent to the schooner, which transmits the messages to the fishing boats by flag signals.

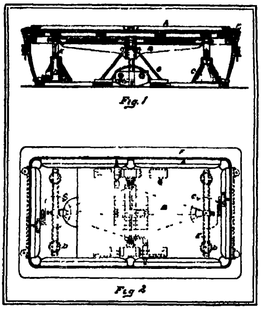
It may be expected that, as the number and frequency of weather reports sent by vessels to meteorological stations increase, the forecasts will become more accurate and more valuable to the vessels which receive them.—Cosmos.

Experiments in abrasion conducted at a French mint have shown that aluminium coins will be less rapidly worn by use than coins made of gold, silver, or bronze.

A BILLIARD TABLE FOR SHIPS.

BY HAROLD J. SHEPSTONE.

To the wide range of amusements now found on the leading liners, billiards may be added in the near future. This has been rendered possible through the invention of an ingenious movable table top by two London inventors, Messrs. Terrey and Warren Hitherto it has been impossible to play billiards at sea, chiefly for the reason that billiard balls, like other things, are inexorably subject to the law of gravitation It seems an undoubted fact, nevertheless, that a billiard table was put into the 'Great Eastern" The assumption may possibly have been that the huge proportions of the mammoth liner would insure so stable a platform at sea, at all events in ordinary weather that the balls would not cannon of their own account If such was the expectation however it was doomed to disappointment. To-day it would be just as impossible to play billiards on the Lusitania' or on the Adriatic," unless they were at anchor, as it was on their precursor of fifty years ago



SIDE AND PLAN VIEWS OF THE BILLIARD TABLE.

A comparatively modern idea—for the question of a suitable billiard table for ships has received the attention of the makers for a considerable time past—was to fit up a ship with a saloon so suspended that it would remain unaffected by the vessel's movements. Its floor, it was hoped, would remain perfectly horizontal, whatever the rolling or pitching and its occupants would be immune from sea-sickness. This notion, despite its humanitarian motives, was doomed to disappointment The swinging cabin did not work satisfactorily in practice. For one thing it proved too jerky, and did not add to the safety or comfort of the ship.

A BILLIARD TABLE FOR SHIPS

A reference to our plans will show how these desirable qualities have been secured *A* is the bed of the table, which is secured to transverse girders, situated near the ends of the table. Each girder carries, at the center of its length, the hollow element of a pivot whose axis is longitudinal to the table, the solid element of the pivot consisting of the shaft *B* This latter is secured to a cross piece, to which is also secured a transverse shaft, which is carried in brackets *G* bolted to the deck of the billiard saloon of the ship. The horizontal position of the bed of the table is maintained by depending counterbalance weights, of which there are three, namely, one at each end, secured to the transverse girder for counteracting the effect of the list of the ship, and a central counterbalance for counteracting the effect of a change of trim *D* is a dashpot to hold the opposite end of the table in balance The two shafts are each carried on ball bearings for the purpose of eliminating friction as much as possible The table shown in our illustration measures 6 feet by 3 feet or three-quarters size A full size table of course, could be erected on the same principle, but space being valuable on board ship, it is probable that the smaller size would be chosen

◆

A Project for the International Exploration of the Atlantic

At the international geographical congress which met recently in Geneva two delegates called attention to the necessity for an international exploration of the Atlantic Ocean and suggested the formation for this purpose of an association similar to that which has already been formed for the study of the seas of northern Europe All Atlantic exploring expeditions of recent years have proceeded southward from Europe and have confined their observations almost entirely to the southern half of the Atlantic Since the memorable voyage of the 'Challenger (1872 1876) and the last American expedition no ship equipped with modern apparatus has made explorations in the Gulf Stream and the northern Atlantic although thorough knowledge of these waters is necessary to a complete understanding of the phenomena of the south Atlantic. Almost nothing is known about the laws and range of temperature and the velocity of currents in the north Atlantic although the variations of temperature of the Gulf Stream undoubtedly exert a powerful influence upon the climate of all northern Europe A study of the meteorological conditions of the northern Atlantic is also greatly needed for through this region sweep the barometric depressions the frequency and paths of which seriously affect the crops of western Europe The connection between hydrographic and atmospheric phenomena about which so little is known also demands study

Many biological problems too await solution The larvæ of the European eel have been found in the Atlantic west of Ireland at a depth of 3 300 feet, and Dr Hjort has found larvæ of other fishes at great depths in the ocean between Norway and Jan Mayen, so that a systematic and scientific north Atlantic fishery would probably produce surprising results. In this connection the quantity and character of the plankton which both directly and indirectly influence the migration of fishes, demand thorough study Finally the exploration of the waters of northern Europe cannot be regarded as complete so long as we remain in ignorance of the currents temperatures and biology of the Atlantic of which the North Sea the Baltic the English Channel etc are dependencies

It is the more remarkable that the north Atlantic is one of the least known of oceanic regions as the most important highways of traffic traverse this region It is true that the profile of the sea bottom has been made known in rough outline by the work of the cable layers but we know very little more of the physical characters of this region.

The Gulf Stream requires especially thorough study because of its great influence on the climate of Europe Voyages of exploration should be made four times each year and the operations should always include measurements of temperature and salinity at various depths and the collection of specimens of plankton and sea bottom All the expeditions should use identical instruments methods, units and constants so that their results may be directly compared with each other In order to save expenses the proposed plan does not include an international bureau of operation, but merely an international commission to prescribe instruments and methods and assign to each government the field which it is then to explore with its own men and at its own expense. The participation of individuals will also be welcomed and sought and the assistance of the great steamship companies is confidently expected.

SECOND HONORABLE MENTION ESSAY ON THE FOURTH DIMENSION.

BY PLATONIDES (P C PERRY)

(Judges—Prof Henry P Manning of Brown University and Prof S A Mitchell of Columbia University)

The schoolboy early becomes familiar with linear measure square measure and solid or cubic measure He understands them respectively as the measurement of lengths the measurement of surface which depends on length and breadth taken conjointly and the measurement of volume which depends on length breadth and height all taken together The first involves one dimension length the second two mutually perpendicular dimensions length and breadth multiplied together and the third three dimensions each perpendicular to the other two—length breadth and height all multiplied together Let the units of these three kinds of measure (e g foot square foot and cubic foot) be represented by a line *AB* a square *ABCD* with that line as side and a cube *ABCD-G* with that line as edge and that square as base (Fig 1) The unit *AB* may be regarded as made up of an infinitely large number *M* of points arranged continuously from *A* to *B* the square *ABCD* then contains $M \times M = M^2$ points and the cube *ABCD G* contains $M \times M \times M = M^3$ points One can go from any point in *AB* to any or every other point therein by following the one fixed direction of *AB* similarly from any point to any or every other in *ABCD* by moving in the two fixed directions of the bounding lines and likewise in *ABCD G* by moving in the three fixed directions of the bounding lines (direction forward or backward being regarded as the same in every case) Hence with regard to motion from one point to another the first unit is one dimensional the second two-dimensional and the third three dimensional

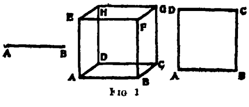


FIG 1

Man can make no motion which cannot be resolved into a combination of three mutually perpendicular directions He can find no place which cannot be reached by going north or south east or west and upward or downward He can find no point in a room which cannot be found by moving in the direction of the length breadth and height of the room Sight reveals two dimensions directly the breadth and the height of the object beheld while the third dimension the distance of the object is estimated by means of the muscular turning of the eyes to focus them on it No sense calls for a fourth direction perpendicular to the other three in fact all of man's experience leaves him satisfied with three dimensions

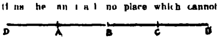


FIG 2

Leaving experience behind and reasoning wholly from analogy the fourth dimension is introduced as follows Four dimensional measure depends on length breadth height and a fourth dimension all multiplied together It involves four linear dimensions each perpendicular to the other three consequently the fourth dimension is at right angles to each of the three dimensions of the three dimensional measure Its unit must have *AB* as edge the square *ABCD* as face and the cube *ABCD G* as base It contains $M \times M \times M \times M = M^4$ points To travel from any point to any or every other point in it is possible by moving in the four fixed directions of its bounding lines

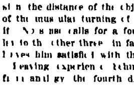


FIG 3

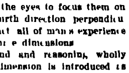


FIG 4.

The square *ABCD* (Fig 1) is derived from the line *AB* by letting *AB* with its *M* points move through a distance of one foot in a direction perpendicular to the one dimension of *AB* every point of *AB* in this motion describes a line and *ABCD* contains therefore *M* lines as well as M^2 points The cube *ABCD-G* is derived from the square *ABCD* by letting *ABCD* move one foot in a direction perpendicular to its two dimensions its *M* lines and M^2 points describe respectively *M* squares and M^2 lines accordingly *ABCD G* contains *M* squares M^2 lines and M^3 points Similarly the four-dimensional unit is derived from the cube *ABCD-G* by letting that cube move one foot in a direction perpendicular to each of its three dimensions i e in the direction of the fourth dimension, its *M* squares M^2 lines, and M^3 points describe respectively *M* cubes M^2 squares and M^3 lines accordingly the four dimensional unit contains *M* cubes, M^2 squares, M^3 lines, and M^4 points Considering the boundaries of the units *AB* has two bounding points *ABCD* has four *ABCD-G* has eight—four each from the initial and the final positions of the moving square—and the four-dimensional unit has 16—eight each from the initial and the final positions of the moving cube Of bounding lines *AB* has one (or is itself one) *ABCD* has four *ABCD-G* has twelve—four each from the initial and the final positions of the moving square and four described by the four bounding points of that square and the four-dimensional unit has 32—twelve each from the initial and the final positions of the moving cube and eight described by the eight bounding points of that cube Similarly of bounding squares *ABCD* has one (or is itself one) *ABCD G* has six—one each from the initial and the final positions of *ABCD* and four described by the bounding lines of the moving square—and the four-dimensional unit has 24—six each from the initial and the final positions of the moving cube and twelve described by the bounding lines of the moving cube Finally of bounding cubes *ABCD-G* has one (or is itself one) and the four-dimensional unit has eight—one each from the initial and the final positions of the moving cube and six described by the bounding squares of the moving cube

If the bounding lines of the square *ABCD* are supposed to be made of a continuous wire and that wire is cut at *D* the boundary may then be folded down into line with *AB* forming a one dimensional figure (Fig 2) of four linear units The original linear unit *AB* has one linear unit at either side of it and an extra one *CD* beyond on one side If the cube *ABCD G* has its bounding squares supposedly made of a continuous sheet of tin and that sheet is cut along the lines *EF GH HE AF BF CG* and *DH* the square faces can be folded down to form a two-dimensional figure of six squares The square *ABCD* has a square at each side of it and an extra one *FEGH* beyond on one side (Fig 3) Likewise if the four-dimensional unit has its bounding cubes made of connected solid wood and this wood is cut through the appropriate planes the cubes can be folded down to form by analogy a three dimensional figure of eight cubes The cube *ABCD G* has a cube at each side of it and an extra one beyond on one side (Fig 4) These eight cubes now forming a three dimensional figure constituted the boundary of the four dimensional unit

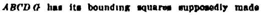


FIG 5

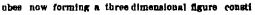


FIG 6

The following table shows the results obtained for the contents and the boundaries of the four units considered

CONTENTS

	Points	Lines	Squares	Cubes
One dimensional unit	M	1	0	0
Two dimensional unit	M^2	M	1	0
Three dimensional unit	M^3	M^2	M	1
Four-dimensional unit	M^4	M^3	M^2	M

BOUNDARIES

	Points	Lines	Squares	Cubes
One dimensional unit	2	1	0	0
Two-dimensional unit	4	4	1	0
Three dimensional unit	8	12	6	1
Four dimensional unit	16	32	24	8

The reasoning used is capable of extension at once to units of five or even more, dimensions.

If the one-dimensional unit is extended indefinitely to the right beyond *B* and to the left beyond *A* so that its length becomes greater than any number one can name it represents a one-dimensional space Similarly the indefinitely great extension equally in every dimension of the other units gives a representation respectively of two-dimensional three-dimensional and four-dimensional spaces

The one dimensional unit is separated from the rest of the one-dimensional space in which it lies by two points the two-dimensional unit from the rest of its two-dimensional space by four lines the three-dimensional unit from the rest of its space by six squares and similarly the four-dimensional unit is separated from the rest of the four-dimensional space in which it lies by eight cubes To inclose an object of any number of dimensions in space of the fixed number of dimensions demands, in one-dimensional space, two points, in two-dimensional space, at least three lines, in three-dimensional space, at least four planes, and, in four-dimensional space, at least five three-dimensional spaces."

"As with the units, so with the spaces, any point can be reached from any other in the same space by moving in as many fixed directions, each perpendicular to the rest, as the space has dimensions

Time represents a one-dimensional space; for it proceeds in one direction only from an indefinitely remote past to an indefinitely distant future (Fig 5) The present is a point traveling through time (or allowing time to slip past it) with uniform velocity, and any point in time can be reached by traveling through a definite distance (in years months etc) from one chosen fixed point (e g the birth of Christ)

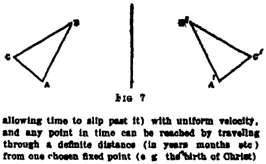


FIG 7

Any portion of the earth's surface regarded as a plane represents a portion of a two-dimensional space and the two fixed directions are those of latitude and longitude An illustration of three-dimensional space is that space—to man's perceptions—in which the universe is placed Man can find no illustration of a four-dimensional space

If two lines *AB* and *B'A* in the same one-dimensional space are symmetrical about a point *O* of that space (Fig 6) *AB* cannot be so moved in that space that the corresponding points shall coincide (*A* with *A* *B* with *B* etc) To effect such coincidence it is necessary to rotate *AB* through two-dimensional space about *O* as a center or roughly speaking *AB* must be taken up into two-dimensional space turned over and put down on *B A* Likewise if two triangles, in the same two-dimensional space are symmetrical with respect to a line (Fig 7) such coincidence of corresponding points and lines can be effected only by rotating one triangle through three dimensional space about the line of symmetry or roughly speaking one triangle must be taken up into three-dimensional space turned over and put down on the other Again if two polyhedral figures in the same three-dimensional space are symmetrical with respect to a plane (Fig 8) coincidence of corresponding points lines and planes can be effected only by rotating one polyhedral figure through four-dimensional space about that plane or roughly speaking one of the polyhedral figures must be taken up into four-dimensional space turned over and put down on the other A right hand and its reflection (a left hand) in a mirror are symmetrical with respect to the plane of the mirror and rotation about that plane would effect coincidence Such rotation would make a right glove become a left glove or roughly speaking a right glove tossed up in the direction of the fourth dimension and turning over there will fall back a left glove

The inability of man to locate the fourth dimension or to detect the existence of a four dimensional space even if it be close at hand is comparable with the inability of a two-dimensional man inhabiting a two-dimensional space to locate the third dimension or to detect the existence of three-dimensional space even though his own space might be part of it as a plane is part of a solid Suppose the two dimensional space represented by this page to be inhabited by two-dimensional beings. They have length and breadth can move in those two dimensions, and are supposedly conscious of them They have no thickness, cannot rise from the paper or sink beneath it and are unconscious of any dimension in such a direction, they have no "upward" and no "downward" Let them have intelligence concerning all within their space to the extent that man is intelligent regarding his universe, let them possess houses and barns and in general let their life be as rich as may be Their houses and barns will have no roofs and no floors, for the bounds of the space itself alone are there Three lines are sufficient to inclose any object in their world, and the flat-man himself is [illegible]

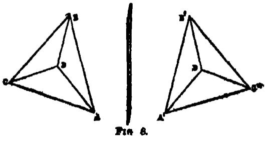


FIG 8.

point, only along his polygonal contour; the interior of his polygon—his own interior—is to be reached only through this contour, for there is no "above" and no "below" within his cognizance. To convince him that a third dimension of "upward" and "downward" exists, touching and leading from even the interior of his polygon—his own internal parts—would be a hopeless task Even if he accepts the arguments from analogy as to the properties of such a dimension, he would rebel at the idea of looking within himself to find it. Yet, even there, at right angles to the two dimensions which he knows, it is to be found—as well as everywhere else in his space. And, similarly, within himself, quite as much as anywhere else, must man look if he is to find the fourth dimension.

Were one to explain to this flat-man that a three-dimensional being, approaching from the direction of that unknown third dimension, could reach within his most securely locked barn and remove its contents without opening a door or breaking a wall—or could touch the very heart of the flat-man himself without piercing his skin—the flat man might still be none the nearer to an appreciation of the third dimension Equally impossible is it for man to understand from what direction a four-dimensional robber must come to steal the treasures from the soundest vault without opening or breaking it—or by what way of approach the four-dimensional physician would reach to touch the inmost spot of the human heart without piercing the skin of the body or the wall of the heart, yet the route of such a robber and of such a physician lies along the fourth dimension. By that route must come the four-dimensional being who is to remove the contents of the egg without puncturing the shell or drink the liquor from the bottle without drawing the cork Such four-dimensional creatures, inhabiting a space containing the three-dimensional space where man lives, would constitute the most perfect of ghosts for man's world, and the absence of such ghosts argues against the existence of a four-dimensional space so situated and so inhabited

Algebra demands that geometry picture all its problems, and since an algebraic problem may contain four or five or more unknown quantities quite as well as any lesser number, algebra demands a four-dimensional, five-dimensional, or higher space for its use quite as imperatively as the spaces of lower dimensions. Perhaps certain phenomena of molecular physics or the mechanical principles of the electric current may find a complete explanation only with the use of the fourth dimension Perhaps the fourth dimension escapes man's discovery only because the measurements in its direction are always very minute in comparison with the measurements in the three other dimensions. Thus far, however the space of four dimensions—and all spaces of more dimensions—may be only "the fictitious geometric representation of an algebraic identity"

A NEW SCOTCH ELEVATING FERRY.

BY WILLIAM CARLIN.

The front-page illustration shows the construction of the new elevating vehicular ferry steamer "Finnieston No. 1," recently constructed at Port Glasgow for the Trustees of the Clyde Navigation under the direction of G H Baxter, Esq., mechanical engineer The vessel was launched with machinery aboard and steam up, the illustration being a photograph taken immediately after the launching The leading dimensions are, length 104 feet, beam 45 feet, and molded depth 12½ feet.

It may be stated that the elevating platform which carries the vehicles has a range of 17 feet and is carried on eight double-threaded buttress screws of forged steel. The screws are hung on collar bearings in cast steel brackets, which are supported by the framing legs. The platform is built up of H girders connected with massive built steel girders on either side of vessel. The supporting screws are fitted with worm wheels at their lower ends, and mesh with forged steel worms.

A triple-expansion, three-crank engine raises or lowers the main platform. An automatic gear is fitted to this engine, so that the platform may not be raised or lowered beyond its intended travel A brass gage in the engine room also indicates the position of the platform in feet and inches.

The lower or main deck is of steel plating, and has no projections above 10 inches. As a result, the platform may drop to its lowest level.

Vertical three-crank, triple-expansion engines are used for propulsion, each engine driving two propellers, one forward and one aft, with two thrust blocks fitted on each line of shafting. The engines are controlled from the house on the top of the framing by balanced [illegible] which actuate the [illegible] the direct-acting steam and hydraulic reversing engines. There are no rudders, the vessel being maneuvered entirely by the propelling machinery. Two reversing handles are situated in the wheel house, one on each side of the man at the wheel.

Correspondence.

THE EGYPTIAN STEAM CULTIVATOR.

To the Editor of the SCIENTIFIC AMERICAN:

In March last I noted a short article in your paper speaking of a steam cultivator by Boghos Pacha Nubar, a farmer in upper Egypt. The description and purpose of this cultivator are both identical with a machine that I was interested in some ten years or more ago, together with a number of others here, a company to promote which was formed, but failed to produce a thoroughly commercial machine By that I mean that although several machines were built, with from two to six rotary disks or tools, as we call them, owing to lack of capital we were not able to put out a machine that would work day in and day out without a break of some kind This we know was only a question of capital and experiments

I write you so as to correct any impression that may exist as to the originality of the machine you speak of for I may add this principle was patented here in Canada more than twenty years ago and should you desire to know more of it, the information could be secured H J ROSS

Montreal, Canada.

THE PROPOSED MONTREAL DRYDOCK.

To the Editor of the SCIENTIFIC AMERICAN

I read in the press of a proposal to have a floating drydock in Montreal, and the following suggestion flashed into my mind as being most suitable for local reasons Instead of a floating dock why not excavate a dock, near the exit of the Lachine Canal in two sections, one the real drydock with the floor just above the level of high water at Montreal, the other in continuation with floor at level of present harbor bottom level

Vessels could then run into the lower section, gates be closed, and water run in from the canal through sluices which would raise the level some 50 feet, or as required, pass the boat into the inner section, close sluices and open outflow, letting the water run out, thus saving pumping, time and expense

At the beginning of navigation perhaps some pumping might be required during the freshets.

This, in my opinion, would be the easiest, cheapest and most permanent way to build a drydock at Montreal VICTOR F CONNOR, L R C P I

Great Village, N S

THE NUMBER OF OUR ANCESTORS

To the Editor of the SCIENTIFIC AMERICAN

May I suggest that Mr McCullough has not solved the problem put by Mr Venning?

No one will deny that, shall we say, John Brown had a father and a mother that his parents each had a father and a mother and so on for (all?) previous generations. It would appear then to follow that x generations back John Brown had 2^x ancestors! This is what Mr Venning says *appears* to be the fact He does not say it *is the fact*, indeed, he asks for an explanation of the difficulty he is placed in in not being able to reconcile this apparent fact with common sense

Would any of your readers explain where the error creeps in? John Brown we know had 2 parents we know he had 2^2 grandparents we know he had 2^3 great parents Why then is it not true that for the xth generation back he had 2^x ancestors?

Bristol, England F C CONSTABLE, M.A.

SIGNALING TO MARS.

To the Editor of the SCIENTIFIC AMERICAN

The possibility of signaling to Mars is merely a question of elementary mathematics. That it should have excited such widespread interest and discussion can have astonished no one more than the writer That in spite of this widespread and in many cases correct exposition by the newspapers there should still remain some who fail to grasp the elementary principles of the problem is my only excuse for what may seem to many of your readers a wasteful use of valuable space in your paper

Reference is here made to two communications in your issue of June 26th The first is by a gentleman connected with Adelphi College, Brooklyn This criticism is that if the signals were sent when Mars was in opposition they could not be seen. The obvious answer would seem to be "Then why send them when Mars is in opposition?" There are two positions of the earth in its orbit when it is invisible from Mars. One is when it is between Mars and the sun, and the other when it is on the opposite side of the sun. So it would hardly seem desirable to send signals to Mars under either of these circumstances. Signals could be sent in any other relative position of the two planets, as has been fully explained in several of the daily papers. This statement will also answer the criticism of the gentleman regarding the perfectly logical and correct suggestion of Prof. Wood, that a signal might also be sent by means of a dark area upon a white field

The first mistake of the other writer is due to the fact that in the cases which he cites, and with which he is familiar, the angular size of the mirror is greater than the angular size of the sun The object of the silvering of the mirror is to change the direction of the rays of light but it really has nothing to do with the question in hand and we may consider for convenience that the mirror has been removed during our experiments and that the sunlight is simply shining through the hole in the frame If now we are very near the mirror so that we see the whole of the sun's disk through the aperture, a 2 inch mirror will transmit just as much light as one ten feet in diameter If however, we go to a distance of several miles, the large hole will clearly let through much more light than the small one

The second mistake of this correspondent is to suppose that the signal would only be seen over a small portion of the surface of Mars In point of fact when Mars was distant one hundred millions of miles from the earth the signal would be seen simultaneously over an area one million miles in diameter No great accuracy would therefore be required in pointing the mirror, as he seems to suppose.

In closing the writer would repeat that the proposition of signaling to Mars is merely a question of the most elementary mathematics. It is a problem which any astronomer can work out in ten minutes' time and which involves no uncertainty whatever When Mars is at a distance of one hundred millions of miles from the earth a beam of sunlight half a mile square would appear to its inhabitants of the same brightness as a fifth magnitude star On account of the brightness of the earth however, it would be quite invisible to eyes resembling our own unless aided by a powerful telescope Whether there are the equivalents of human eyes and telescopes upon Mars is another question entirely and has nothing whatever to do with the case

WILLIAM H PICKERING

Harvard College Observatory

Official Meteorological Summary, New York, N. Y., June, 1909

Atmospheric pressure Highest 30 23 lowest, 29 69, mean 29 97 Temperature Highest 92, date 25th, lowest 53 date, 10th, mean of warmest day 82 date 24th coolest day 56 date 9th mean of maximum for the month 78 mean of minimum 63, absolute mean 70 5 normal 69 1 excess compared with mean of 39 years, 1 4 Warmest mean temperature of June, 72 in 1888 1892 1899 1906 coolest mean, 64 in 1881, 1903 Absolute maximum and minimum of June for 39 years 97 and 45 Average daily excess since January 1st 2 0 Precipitation 3 17, greatest in 24 hours, 0 70 date 4th and 5th average of June for 39 years, 3 21 Accumulated deficiency since January 1st 0 19 Greatest precipitation, 7 70 in 1877 least 0 86 in 1894 Wind Prevailing direction southwest total movement 7 014 miles average hourly velocity 9 7 maximum velocity 43 miles per hour Weather Clear days, 7, partly cloudy 12 cloudy 11 on which 0 01 inch or more of precipitation occurred, 12 Thunderstorms 22nd 25th 27th, 28th

The Current Supplement.

The opening article of the current SUPPLEMENT, No 1750 discusses wild animals in captivity A novel electric locomotive is described and illustrated The astronomical clock at Lyons is an interesting article by Charles A Brassler The indestructibility of matter is treated by Prof G Zenghelis Col Sir Frederic L Nathan's admirable paper on guncotton and its manufacture is concluded W C Horsnaill writes illuminatingly on the subject of tidal power The article should prove most helpful to inventors of tidal and wave motors. A *résumé* of F W Lanchester's discourse on aerial flight presented before the Royal Society of Arts is published An apparatus is described for studying the friction of metals experimentally An interesting article is that by C Ainsworth Mitchell on the making of handwriting Prof John Joly the distinguished geologist contributes an article on radio-activity of deposits and the instability of the earth's crust

The smelter production of lead in the United States in 1908 as given by C E Siebenthal of the United States Geological Survey, under date of May 24th was 408,523 tons of 2,000 pounds, against 442 015 tons in 1907, and 418 699 tons in 1906 The production of refined primary lead, which embraced all desilvered lead produced in the country and the pig lead recovered from Mississippi Valley lead ores was 398 433 tons against 414 189 tons in 1907, and 404 669 tons in 1906 The antimonial lead produced was 13 629 tons and the recovered or secondary lead 18 281 tons In 1908 the lead smelted from domestic ores was [illegible] tons and from foreign ores and foreign base bullion (almost wholly Mexican), 97,761 tons

CONSTRUCTING THE CONCRETE LOCKS OF THE PANAMA CANAL.

BY H. PRIME KIEFFER.

The final plans for the locks of the Panama Canal have just been adopted, and the accompanying drawings will serve to illustrate the colossal proportions of these great engineering works. They are to be constructed wholly of that newest of building mediums—concrete, and it is extremely doubtful whether the great waterway would have been designed upon its present ambitious lines, had not concrete gained the powerful prestige as a building material which it now holds. A number of other giant structures, such as the Gatun spillway and various dams, culverts, diversion tunnels, etc., are being carried out in this medium, but the most interesting of all will be the mammoth locks. They will be by far the largest and longest concrete structures of the kind in the world, and it is improbable that they ever will be exceeded.

The locks will be six in number, three at Gatun on the Atlantic side of the Isthmus, one at Pedro Miguel, and two at Miraflores, both of these latter points being on the Pacific side of the Isthmus. The channel from Gatun to Pedro Miguel will lie in Gatun Lake at an elevation of 85 feet above sea level.

The adopted plans call for locks 1,000 feet long, 110 feet wide, and all in duplicate, that is to say, with two sets of locks side by side. The three locks at Gatun will be built as a continuous structure, and together with the piers at either end they will have a total length of 4,800 feet, all of massive and continuous concrete work. At Pedro Miguel the one lock with piers will have a length of about 1,500 feet, and at Miraflores the two locks and piers will be about 2,800 feet in length. The building of these locks will necessitate the use of about 8,000,000 cubic yards of concrete, which, if loaded on the 20-yard cars in use on the canal, would reach sixty times across the Isthmus, or it would make a string of such cars reaching from New York to Chicago, to New Orleans, and back to Chicago again. Cement alone to the amount of 900,000 tons will be employed.

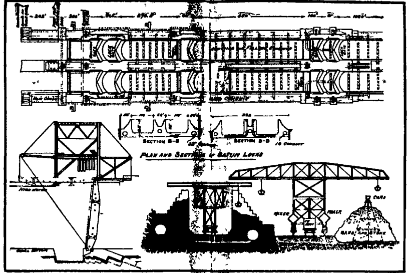
In addition to their size, the locks will present many interesting studies in their safeguarding features and in the mechanical and electrical devices for the opening of the gates, the rapid unwatering of the locks, towing of vessels, etc. These appliances, as well as the very locks themselves, have been designed with such care and skill that the factor "human frailty" cannot possibly play the important rôle which the enemies of the lock type would have us believe.

The locks will have plate-steel hinged arch gates in duplicate, and these gates will be protected by massive fender chains stretched across the locks ahead of the gates to take up the shock in case a vessel approached the gates too rapidly. Although these chains are not designed to absorb the total shock, they will check the vessel's speed and thereby protect the gates. In addition to this precaution, the vessels will be required to come to anchor at the piers outside of the locks, and the towing ropes will there be made fast. Then by the aid of mechanical "mules" located on top of the lock walls, the vessel will be towed through the locks at a uniform speed and the vessel held in perfect control. This can be readily accomplished, as there will be no tides or storms with which to combat. The gates are of exceedingly massive construction, set in walls of solid concrete 10 to 60 feet in thickness.

As a precaution against the carrying away of the lock gates by a similar accident to that which recently occurred at the Soo Canal, they are being built in pairs, with a water space of about 80 feet between them. The first gate will serve a similar purpose to that of the heavy guard chain above referred to. Should a vessel break through the guard chain, which would check its speed, it would bring up against the first set of gates, which are of such enormous strength that they would be certain to check the vessel's way. Should they be broken, the water would still be held by the second set of gates. As an additional precaution, however, and in the inconceivable event of both gates being broken down, at the Gatun end of the lock there will be built a huge structural steel wicket swinging dam, similar in principle to that which was used effectively in stopping the rush of water at the Soo Canal. The structure is nothing more nor less than a massive swinging bridge similar to a railroad drawbridge. On the under side of the floor are attached about a dozen heavy steel girders, which are hinged at the edge of the bottom floor, which is downstream when the dam is swung across the canal entrance. The other ends of the girders are attached to hoisting and lowering cables, electrically operated. To close the waterway the dam is swung around across the entrance, the girders are lowered until their bottom ends rest upon bearings countersunk in the floor of the canal, and then a series of transverse steel plates or "wickets" are lowered in succession across the face of the girders, gradually closing the channel from the bottom upward until the passage is entirely shut off.

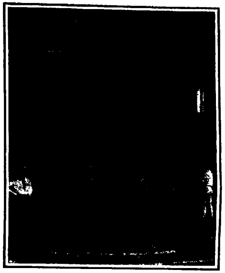
Another feature of the locks which, because of its great magnitude, is of unusual interest, is the system of conduits by which the locks will be filled and unwatered. Below the floor of the locks, and arranged transversely to their axes, is a series of large conduits fed by numerous openings through the floor. These conduits lead into larger conduits built in the walls of the lock, which range in diameter from 18 to 22 feet. In the latter are set the huge gates by which the flow of the water into or out of the lock is manipulated. There are over one hundred ducts opening into each lock, and because of their number and uniform distribution there will be no disturbing currents in the water, and the filling and emptying will be done with unusual rapidity.

Portable grab bucket crane unloading crushed rock from scows in the old French canal at the Gatun docks



Cross-section of emergency dam in the closed position, with wicket girders down and sliding gates partly in the lowered position

Diagram showing method of building the locks at Pacific end of canal. Sand and stone are lifted from the stock pile to the mixers, and from the mixers the concrete is carried to the lock site by the two cantilever cranes

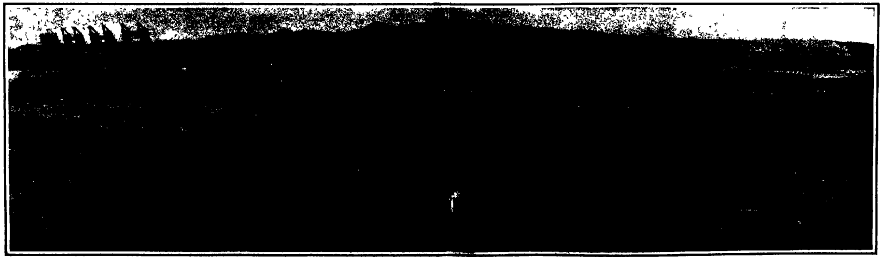


One of the concrete mixers dumping its load into steel cars for transportation to the overhead cableway that spans the Gatun locks

How the 4,000,000 cubic yards of concrete are being mixed and built into place at the Gatun locks

The Gatun dam is 115 feet high, 2,400 feet wide, and about 9,000 feet long. Near the center is a natural hill of rock, through which it was decided to build the spillway. The above photograph is taken looking through the completed spillway excavation, which will be lined with a heavy covering of concrete both on floor and sides. Concreting has commenced and is now well under way.

Excavation for spillway in center of Gatun dam



In the forefront are four completed towers of the cableways which will span the twin locks. In the distance are four corresponding towers in course of erection. Between and running from right to left is the excavation for the locks, which will be 880 feet wide and 3,800 feet long. They will consist of a huge monolith containing 4,000,000 cubic yards of concrete. The concrete will be brought to the cableways from the mixers in electrically-operated cars, picked up by the cableway, and deposited in place.

Excavation for the Gatun locks, showing the lofty steel towers for the construction cableways.

CONSTRUCTING THE CONCRETE LOCKS OF THE PANAMA CANAL.

MATERIAL HANDLING PLANTS FOR THE LOCKS.

Naturally the plant employed in the construction of such large structures, involving the laying of 8,000,000 cubic yards of concrete, is extraordinary in size and calls for much ingenuity of design. There are in the United States and in Germany some very large, interesting and economical plants for the mixing, transportation and placing of concrete, but the one now about completed at Gatun will surpass in magnitude anything ever attempted. The plant at Gatun will be used for all three of the locks, as they are to be built practically as one monolithic structure. The lock at Pedro Miguel and the two at Miraflores will for several reasons demand entirely different material handling plants.

At Gatun about 4,000,000 cubic yards of concrete will be employed. The crushed stone, the sand and the cement for this concrete will be handled in the following manner: The crushed stone will come from Porto Bello, a small hamlet about 20 miles east of Colon along the Atlantic coast. The rock will be taken from the quarry by steam shovels and sent by gravity to the giant crushers, and thence by gravity to the barges in the harbor. From this point it will be carried to Cristobal, at the Atlantic entrance to the canal, and thence via the old French channel to the docks at Gatun. Here it will be unloaded into storage bins by giant grab buckets operated from cableways suspended between two sets of towers on either side of the channel.

The sand will come from Nombre de Dios, about 40 miles along the coast from Colon. It will be taken from the sand pits by clamshell buckets, loaded into steel barges, and taken to Gatun, where it will be unloaded by a process similar to that of unloading the crushed rock. The cement is now being shipped from New York. At Colon the cement will be transferred to barges and taken *via* the old French channel to Gatun and unloaded to the storage yards. The rock and sand storage piles have a capacity of about 300,000 cubic yards, while the cement yard accommodates about 100,000 barrels. From these storage buildings the rock, sand and cement will be delivered through valves to charging cars running underneath. These cars, which are electrically operated, carry the materials to the concrete-mixing machines located nearer the locks site and discharge it direct to the machines. About eight of these machines will be employed on the Gatun locks. After the concrete is mixed it will be dumped into buckets set on flat cars, and the cars will be run to position under the great cableways spanning the locks site, and from these cableways the buckets filled with concrete will be swung to position on the locks under construction.

The concrete-handling plants at Pedro Miguel and at Miraflores will be essentially different from the one at Gatun. It is desired to prosecute work simultaneously at all the locks, and therefore the great cableways and other plant at Gatun could not be used on the Pacific side. The plant at Gatun will be economical because the three locks there are all continuous. It would not be economical to build other similar separate plants at both Pedro Miguel and Miraflores. In addition to this fact, the ground surrounding the locks at these two latter points is very unstable, and it would be unwise to place the great towers there. In their stead, therefore, there will be used a system of cantilever and berm cranes. These cranes will take the materials from storage and from cars, and after mixing will deliver the concrete to place in the lock forms. It will be recalled that the materials at Gatun will be delivered by water, while at Pedro Miguel and Miraflores they will come by rail. As there is but one lock at the former point, the plant there will be taken upon completion of the lock to Miraflores to assist in the work on the two locks at that point.

The cantilever cranes are set on towers which rest on trucks running on tracks parallel to the lock walls. These cranes will travel the full length of the locks and of course parallel to them. They are situated outside of the locks. They will gather the material from the storage piles and with the aid of grab buckets drop it into the concrete-mixing machines situated in the towers. The inner arms of the cranes will then be used to transfer the concrete to the outside lock walls and to the smaller or berm cranes, which will in turn place it in position on the foundation and center wall between the locks at points inaccessible to the cantilever cranes. The guaranteed capacity of the plant on the Miraflores locks is about 2,500 cubic yards of concrete per day That of the cranes at Pedro Miguel is about one-half this, as the structure will be only half as large as the ones at Miraflores All of the cranes, cableways, mixers etc, will be electrically operated and the power plants for furnishing the current are now about completed

The forms for the concrete walls are to be of steel and will all be interchangeable, which will allow them to be used on successive stages of the work The circular forms for the water conduits machinery chambers etc, will all be of the rapid collapsible sheet steel type

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FOODS AND DIGESTION

The subject of food and its digestion is one of the most important with which the human family is concerned and yet strange to say, there is very little known about the comparative digestibility of foods by the average person

To present certain facts relative to digestion we have prepared an engraving which shows the relative digestibility of foods of various kinds It will be seen that the baked apple and the raw egg are near the winning post the egg being tied by the fish Then follows venison all these being digested within an hour Then come milk turkey duck and oysters New bread and cheese follow in the same class with the above the time required to digest them being about three hours Then come turnips potatoes roast chicken and cabbage We are fast getting into the period of indigestibility which is beautifully summed up in pork and veal which require under the most favorable conditions five hours to digest In the sixth hour and beyond class we find jam crabs and alcoholic beverages of various descriptions Certain other articles of food are about as bad as crabs and jam notably eels which are notoriously indigestible requiring six hours also stone fruits, which require the same period

THE RACE OF FOODS FOR FIRST PLACE IN THE DIGESTION RACE.

It will be seen by our engraving that as a rule, cooking facilitates digestion partly by softening the food and partly by inducing chemical changes which would otherwise have to be induced by functional activities. Fat retards digestion as it has to undergo a long process of emulsifying before being absorbed This accounts for the indigestibility of pork

Under normal conditions it is well that the digestive process should not be prolonged beyond four and one-half hours For invalids and others with weak stomachs the time should be much less As a result of repeated experiments the following digestive time table will be found of considerable interest

Food	How Prepared.	Time. Hours	Minutes.
Apples, sweet	Raw	1	30
green	Stewed	1	85
Asparagus	Boiled	1	30
Barley Soup		1	30
Barley	Boiled	2	00
Beans	Boiled	2	30
	Puree	1	30
Beef, lean	Roasted	3	00
tender	Stewed	2	45
Beefsteak	Grilled	3	00
Beef, fresh salted	Boiled	2	45
old salted	Boiled	6	00
Beets	Boiled	3	45
Brains	Boiled	1	45
Bread, fresh	Baked	3	30
Butter	Melted	3	30
Bread and Butter (with coffee)		4	45
Cabbage	Pickled	4	30
Celery	Boiled	1	30
Chicken	Boiled	2	00
	Fricasseed	2	45
"	Roast	4	00
Cheese, old		3	30
Custard	Boiled	2	45
Duck	Roasted	2	00
Eel	Roasted	6	00
Eggs, fresh	Raw	2	00
	Soft boiled	3	00
	Hard boiled	4	00
"	Whipped (raw)	1	30
"	Scrambled.	3	00
Fish (other than fat varieties)	Boiled	1	30
" "	Fried	3	00
Fowls	Boiled	4	00
	Roasted	4	00
Game (most kinds)	Roasted	4	15
Goose	Roasted	2	30
Hashed meat	Warmed.	2	30
Liver (calves)	Fried or sauteed	2	30
" (ox)	" "	3	00
Lamb	Grilled	2	30
Lentils	Boiled	2	30
Milk	Raw	2	15
"	Boiled	2	00
Mutton	Boiled & Broiled	3	00
lean	Roasted	3	15
Nuts	—	5	00
Oysters	Raw	2	55
"	Stewed	3	30
Onions	Stewed	3	30
Peas	Boiled	2	30
Pig sucking	Roasted	2	30
Pork fat	Roasted	5	15
" salt	Boiled	3	15
Potatoes	Fried or baked	2	30
Rice	Boiled	1	00
Salad	Raw	3	15
Sausage	Grilled	3	30
	Smoked	5	00
Suet	Boiled	5	30
Sago	Boiled	1	35
Soles	Fried	3	00
Spinach	Stewed	1	30
Salmon fresh	Boiled	1	30
" smoked	Boiled	4	00
Stone Fruit	Raw	6	00
Tapioca	Boiled	2	00
Tripe	Boiled	1	00
Trout	Boiled	1	30
Turkey	Roasted	2	30
	Boiled	2	15
Turnips	Boiled	3	30
Veal	Roast or Grilled	5	00
Venison	Grilled	1	00

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Spontaneous Combustion of Textile Fibers.

Unspun and uncarded textile fibers collected in large masses have caused many conflagrations through spontaneous combustion It appears to be established that clean fibers do not ignite spontaneously and that the combustion is due to the impurities which consist chiefly of oils used in the preparation of the fibers and of the natural grease of unwashed or insufficiently washed wool The refusal of a shipping company to transport shoddy in a ship's hold has led a German investigator to make comparative studies of the shoddy and the fibers which were accepted for shipment, in regard to the nature of their impurities and the degree of spontaneous heating to which they are subject. The admitted fibers included unwashed wool containing 6 to 21 per cent of grease washed wool containing about 3 per cent of grease, wool cardings and combings containing 2 to 3 per cent of added oil and raw cotton containing about ½ per cent of grease The shoddy contained from 1 to 5 per cent of oil The experiments were conducted by compressing with the hands about 2 ounces of the fiber into a ball surrounding the bulb of a thermometer, placing the ball in a wool oven heated to 230 deg F, and reading the thermometer at intervals until the temperature ceased to rise The first series of experiments were made with cotton, with which increasing quantities of oil were incorporated in successive experiments. A curious and inexplicable fact was observed The cotton to which no oil was added and which contained only 1/6 per cent of fatty matter showed at the end of two hours an elevation of temperature of 16 deg F above the constant temperature of the oven.

Very dirty unwashed wool, which lost 64 per cent of its weight in washing, showed a superheating of 21½ deg F in five hours Wool washed in three baths of boiling petroleum naphtha for three hours, superheated 11 deg F in three hours, and the same wool after the addition of 10 per cent of olein superheated 21½ deg F in three hours. Five specimens of wool shoddy, containing a maximum of 5 per cent of olein and a maximum of 10 per cent of cotton, showed elevations of temperature varying from zero to 18 deg. F. in three hours or more. The conclusion is that spontaneous combustion cannot occur in fibers containing less than 10 per cent of fatty matter, and that such fibers may safely be stowed in the hold of a ship.

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The Chemist in the Soap Factory.

In view of the lively competition which prevails in the soap industry it is necessary to exercise constant control, by chemical analysis, over everything, from the raw material to the finished soap and by-products. In the analysis of raw material great care should be taken to obtain fairly representative specimens. In analyzing animal fats it is only necessary to determine the proportions of water, ash, dirt (matter insoluble in ether), free fatty acids, and unsaponifiable matter From these data the yield of glycerin and fatty acids can be calculated In vegetable fats it is necessary to determine the proportions of water, dirt, unsaponifiable matter, the iodine ratio, and in some cases the saponification ratio and the amount of free fatty acids It is often necessary, also, to apply iodine, saponification, titration, and color tests to the fatty acids after separation.

As the proportions of the different fatty acids in a mixture can be determined only approximately (to 5 or 10 per cent) by these methods, it would be very desirable to have all the constants, especially those of the most largely used fats and oils, accurately remeasured Another desideratum is an agreement among soapmakers to employ similar methods, in order to prevent controversy in buying and selling.

The alkalies employed must be analyzed quantitatively for caustic and carbonated alkali and sometimes for the proportions of soda and potash The purity of the acids and other chemicals used in bleaching and clarifying should also be tested

The actual soapmaking should be left to the practical soapmaker, but the chemist should always determine the excess of alkali or of fatty acid in the finished product, in order that the manufacturer may give guarantees of quality

Finally the residual liquors must be analysed for glycerin, salt, impurities, and alkali

Another extensive field of work is open to the chemist in devising and testing new processes and products, and improvements in manufacture.

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The Beginning of Iron.

It is commonly believed that the use of iron commenced in either Africa or Asia, but Ridgeway, in his recently published work "The Beginning of Iron," states that the latest investigations prove that iron was not worked in Egypt until the ninth century before the Christian era or in Libya until 450 B C., that the Semites adopted its use still later, and that it has been known in Uganda only within the last five or six centuries. In China iron is first mentioned in 400 B. C Bronze weapons were employed in China until 100 A D, and in Japan until 700 A. D According to Ridgeway, the metallurgy of iron must have originated in central Europe, especially in Noricum, which approximately represented modern Austria and Bavaria Only at Hallstatt and in Bosnia and Transylvania, from which countries the Achaians and Dorians are supposed to have migrated to Greece, are found evidences of a gradual introduction of iron, at first as an ornament applied to the bronze which it ultimately displaced Everywhere else, iron was introduced suddenly—a fact which implies a foreign origin. Of course, Ridgeway does not assert that iron was unknown outside of central Europe. On the contrary, he states that meteoric iron was known in Egypt in remote antiquity, but that it was worked as flints were worked, by cutting or chipping, and was not smelted. In other words, it was the metallurgy not the knowledge, of iron that originated in central Europe.

Handy Man's Workshop

HOW TO MAKE CONCRETE POTTERY—III.

BY RALPH C DAVISON

(Continued from the issue of June 26th, 1909.)

The last two articles described the method of making individual pieces by means of modeling or building up on wire frames This is perhaps the quickest and easiest way when there are but few pieces of a kind to be made, but when a number of duplicate pieces of one design are required, it is too slow a method to be used for commercial purposes Therefore, when a number of duplicate pieces are wanted it is best to make up a regular mold into which the concrete or Portland cement mortar is poured in a liquid or almost liquid state These molds are usually made of plaster of Paris The method of making them of course differs according to the design of the piece to be cast, but when one has mastored the method of making one or two designs it is easy to make others, for the reason that the general principles are the same throughout

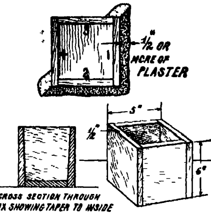


Fig 8—THE WOODEN MODEL AND PLAN VIEW SHOWING PLASTER APPLIED

In all mold work the first thing required is a pattern or model of the piece which is to be produced If the design is an original one, having relief work, and is to be reproduced from a drawing the first thing to be done is to model it in clay and from this clay model the plaster mold is cast

If the design is simply that of a square or round box devoid of all ornamentation or relief work the model can be made of wood or any other material In many instances, it is desired to reproduce articles of a more or less ornate design which one has already in hand or which one can procure such as metal or china ornaments, vases jardinières, etc In this case, the mold can be made directly from the piece which it is desired to reproduce

A plaster mold of a simple piece such as a square pot can be made according to the following directions The model for this can be made of wood The dimensions indicated in Fig 8 are used merely as an example any other dimensions can be used as the piece can be made as large or as small as desired or it may be made oblong When the wood model is put together it should be well shellacked and oiled Use fairly heavy oil or vaseline This is done to prevent the plaster from sticking. Now place the model on the working board, which should also be oiled and then take two pieces of modeler's clay and place them on the model at opposite corners, as indicated at A and B in Fig. 9. If modeler's clay is not handy or easily obtainable, you can make two strips of wood shaped as indicated at C and lightly tack these in position on the corners in place of the clay Shellac and oil the faces of these strips The box is now ready to receive the plaster, which should be mixed as follows Enameled tin or iron ware makes the best thing to mix plaster in, as it is easily cleaned Place a handful of plaster in your tin and add plenty of water to it, mix it up until it is of the consistency of a thin paste Dip your hand into this and scoop the plaster up and throw it on the sides of the model Cover the sides completely, and keep adding plaster until the sides of the model are covered with at least ¾ inch of plaster if thicker no harm will be done This operation will have to be done quickly for if not the plaster will set or become hard in the tin before you can use all of it When it has once set before it is used, it has to be thrown out and another mix made

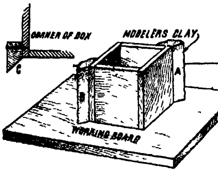


Fig 9.—SHOWING THE CLAY PLACED AT CORNERS OF MODEL.

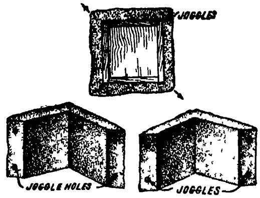


Fig 10—PLAN VIEW OF MODEL, ALSO TWO HALVES OF MOLD, SHOWING JOGGLES.

The piece will now appear as indicated in the plan view Fig 9 Let the plaster which has been deposited on the sides 1 and 2 set for about 10 or 15 minutes and then remove the strips A and B Cut holes about ¼ of an inch deep into the plaster on the surfaces formed by the strips A and B These are called joggle holes and are provided so that the plaster mold when finished will fit together properly Shellac and oil the faces of the plaster as well as the sides 3 and 4 of the wood model, and proceed to deposit the plaster on these as was done on the sides 1 and 2 Care must be taken in all of the above operations not to move the model from its original position on the working board The model and plaster sides should now look as shown in Fig 10 Before removing the plaster sides level them off to the height of the model Now lift the whole up from the working board If care has been taken in oiling all sides of the model a slight jar will loosen the plaster from it Then pull apart as indicated by the arrows the two plaster sides of the mold

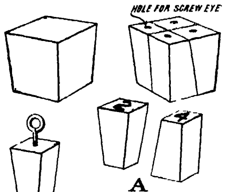


Fig 11—DETAILS OF THE PIECE CORE.

Lay these aside and then proceed to make the core or the part of the mold which forms the hole or the inner sides of the box This is made as follows It will be noticed that in the wood model of the box which is shown in Fig 8 a slight taper is given to the inside This taper is provided so that the core will draw out more freely than if the sides were perfectly straight. Place your model on the working board Shellac and grease well the inside of the box, and then mix the plaster as before, and pour it into the inside of the box Level the top and let the plaster set for 10 or 15 minutes Now turn the box upside down and tap it gently This will loosen the plaster core, and it will fall out If the core should for any reason stick to the sides the wood model should be opened a little so that the core can be taken out without injuring it The core will then be in one piece as indicated in Fig 11 It should now be smoothed up nicely and all corners and edges should be made round. Where a marked taper has been given to the core it might be, if well oiled, used solid in the mold when casting the cement.

It is far better however, to make what is known as a piece core as this can be removed more readily and is less liable to break the cement on removing than is the solid core To make a piece core cut the solid core shown in Fig 12 into four parts as indicated at A This can be done with an ordinary wood saw If the saw binds or sticks a little water applied to the blade will obviate the trouble Mark the pieces thus cut 1 2 3 4 as indicated care being taken to get the proper numbers on the right pieces as this is the rotation in which they are to be removed from the cast Piece number 1 which is a decided wedge in shape should be taken out first and it is well to provide in the top of this piece as well as in the other pieces a straight round hole in which a screw eye of suitable size can be screwed By passing a piece of wood through the eye of the screw the piece can be easily pulled out from the mold

After having cut the core and fitted it together nicely as shown in Fig 11 put it back into the wood model If necessary tie a string around the pieces to hold them in place Also before putting the core into the model, place in the bottom of the model a thin strip of wood about ⅛ of an inch thick will be thick enough This will allow the core to project ¼ of an inch above the sides of the model as shown in Fig 12 Taper this ¼ inch projection of the core as shown and then place in position on the outside of the model the outside plaster molds which have already been made Tie a string around these to hold them firmly in position

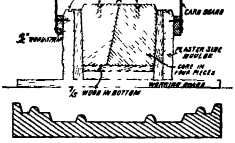


Fig 12—PARTS ASSEMBLED FOR CASTING THE PLASTER CASE, ALSO SECTION OF THE PLASTER CASE.

Now secure by means of brads or fresh plaster strips of ½ inch wood around the outside mold as indicated about ¼ of an inch from the top Taper the edges of the plaster mold from the point where the wood is attached to the top as indicated This can readily be done by cutting the plaster with a knife

Joggles or holes should be made in the top of the outside plaster mold as well as in the top of the pieces of the core as indicated These will help greatly in holding together as well as in assembling the various pieces of the mold Now secure to the strips by means of tacks a 1 inch strip of heavy card board around the entire outside mold Shellac and oil well the entire inside of the inclosure thus made Now mix your plaster as before and pour it over the top of the core the model and the top of the outside plaster mold The cardboard sides and wood strips already attached will prevent the plaster from running down the sides Smooth the plaster off level with the top of the cardboard and let it set or harden When hard turn the whole upside down and by gently jarring the piece just cast will come off freely This piece is called the case It will have the form shown in section in Fig 12 and is used as shown in Fig 13 for setting up the core and outside plaster mold in which to cast the cement box In fact it forms part of the mold

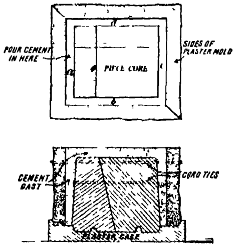


Fig. 13.—PLASTER MOLD SET UP FOR CASTING CEMENT

Before casting the cement box it will be well again to shellac and oil all parts of the plaster mold which will come in contact with the cement Then set up the mold as shown in Fig 13, care being taken to bind the outside form firmly together by means of string The mold is now ready to receive the cement mixture which should be made as follows Take 1 part of Portland cement and 2 parts of marble dust, if a fairly light color is desired If not, 2 parts of any good clean fine sand will do Mix these thoroughly together while dry and then add enough water to allow the whole to be mixed to the consistency of a heavy cream Let it be thin enough so that it will pour freely Pour this mixture in the openings a, b, c d between the outer plaster mold and the core until the mixture is flush with the bottom of the core Lift the mold and gently jar it This will tend to settle the cement and will also force out any air that may be in the mold and thus avoid the trouble of air bubbles or voids in the finished cast The cement already deposited in the sides will settle more or less under this treatment Now fill the remaining portion of the mold flush with the top of the outside plaster sides and jar the mold again Repeat this operation until the cement will settle no more Wipe off the top of the mold with a straight edge thus removing any surplus cement and giving to the bottom of the box a good even surface Then place the mold in a level position and allow it to stay there without moving for from 24 hours to 48 hours the longer the better as the longer it is allowed to remain the harder the cement will set After having set for the above-mentioned time the piece can be removed from the mold The method of doing this is as follows

Turn the mold over into the position shown in Fig 12 tap the case A around its edges this will loosen the case which is then removed Now take the screw eye and insert it in the hole in the piece 1 of the core Pull this out and then repeat the operation in pieces 2 3 and 4 of the core Cut the string which binds the sides together and then pull them off in the directions indicated by the arrows in Fig 10

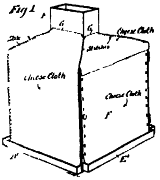
If care has been taken throughout all of the above operations the result will be a perfect cast The next step is the curing of the box This is a simple operation All that is necessary is to soak it well with water This can be done by placing the cast directly in water and letting it stay there for one or two days or it can be sprinkled or dashed with water three or four times a day for two or three days in succession or longer the longer the process is kept up, the better the result By the application of plenty of water the product produced will become as hard or harder than stone

(*To be continued*)

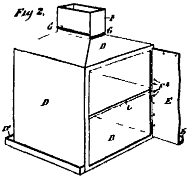
ICELESS REFRIGERATION

BY EDWARD THORPE

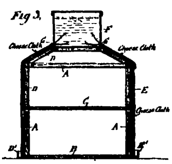
While the mad race for supremacy between the mercury and price of ice continues much comfort can be taken in the fact that there are other methods of keeping victuals cool besides that of melting ice in an ice box If in changing from the solid to the liquid state water absorbs sufficient heat to keep an ice box cool it is equally true that a change from the liquid to the gaseous state will result in refrigeration provided of course the rate of vaporization keeps pace with the heat which enters the ice box from the outside atmosphere Under proper conditions it is possible by this method to maintain a sufficiently low temperature in the ice box to preserve food from rapid decay A simple method of making such an iceless refrigerator is illustrated in Fig 1 In this illustration the cover of the water tank is removed The box comprises a frame A which is built upon a wooden floor B The frame A serves as a support for a zinc box D, which is fastened thereto The water tank F is soldered to the top of the box while at the bottom is a trough D' The door E at the front of the box has its own trough section E' Slots G are cut in the four sides of the tank F to receive the ends of a cloth cover for the box The cover is preferably made up of several thicknesses of cheesecloth stitched together at the corners, and the ends are jammed tightly through the slots into the water tank F The door E is provided with its own section of cheesecloth, as indicated in the illustration In operation the water from the tank soaks into the cheesecloth and by capillary attraction and gravity passes on down to the bottom of the cloth, where any excess of water is caught in the trough The flow of water through and over the cloth should be very slow, and may be regulated to a large extent by the tightness with which the cloth is stuffed into the slots G



REFRIGERATOR COMPLETE WITH TANK UNCOVERED

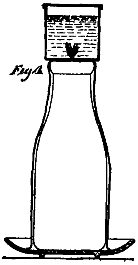


CLOTH REMOVED TO SHOW THE ZINC BOX



CROSS-SECTIONAL VIEW OF REFRIGERATOR.

The box is placed on a suitable shelf supported by brackets just outside of the open window on the breeziest side of the house and out of the direct rays of the sun It is advisable to make the box a couple of inches narrower than the window opening so that the currents of air passing in and out of the window may have free passage all around the moist cheesecloth As the water in the cheesecloth is evaporated it absorbs a large amount of heat, much of which is taken from the zinc box tending to keep the food in the box cool A modification of this idea is shown in Fig 4 Here the construction is adapted to cool an individual milk bottle The cloth covering is placed directly over the bottle and at its upper end is jammed into a slot in the bottom of the small reservoir The milk bottle is placed in a saucer which serves as a trough to catch the excess of water Instead of the cheesecloth covering the leg of a sock can be used as this is already of cylindrical form and is well adapted to hold the moisture In case the water from the tank does not moisten the cover sufficiently the trough may be also filled and the water will be drawn up therefrom by capillary attraction



HOW TO KEEP A MILK BOTTLE COOL.

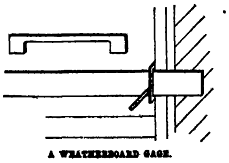
A WEATHERBOARD GAGE

BY I G BAYLEY

It is customary when cutting off weatherboarding to fit up against the corner strips of a frame house to use the long square or carpenter's rule The square is sometimes held along the edge of the weatherboard or down the side of the corner strip Either method necessitates carrying the square along or fetching it from where it was laid down

One-quarter the time can be saved saying nothing of the convenience by making a little gage as illustrated from a piece of board about 9 inches long and 2 inches wide, which can be carried in the nail or apron pocket The notch in the piece is 6½ or 7 inches in length and about 2 inches deep

The weatherboard is held in position, the end not shown being set firmly against the last board in the same row, the other end extending beyond the corner strips. The gage is slipped over this end of the board, and held firmly against the inside face of the corner strip, while a pencil line is quickly drawn across the board as it is held against the gage. The saw cut is made a little inside the pencil mark.

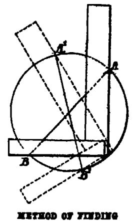


A WEATHERBOARD GAGE.

QUICK MEANS FOR FINDING THE CENTER OF SHAFTS.

BY ALBERT PRATHER.

In the illustration the circle represents a section of a shaft, the center of which it is desired to find. The corner of a square is placed on any point of the circumference The points A and B are the intersections of the outer sides of the square with the circumference. Draw a line from A to B Now shift the square a little as represented by the dotted square, and with the corner on any other point mark the intersections A' and B', then connect A' and B', and the intersection of $A B$ and $A' B'$ will be the required center It is necessarily the center, for it is the intersection of two diameters.

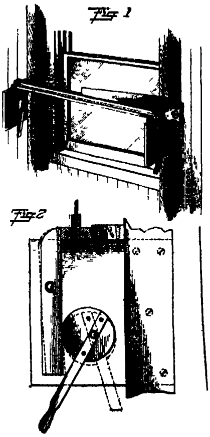


METHOD OF FINDING CENTER OF A CIRCLE.

A HOME-MADE SAW VISE.

BY JAMES G NEWLAND.

Desiring a saw-filing vise that would allow an ordinary saw to be filed or set from end to end without change and without chattering, to hold the saw rigidly and yet so that it could be instantly released the writer made a device as follows In the barn loft there was a south window with a good light. To the 2 x 4 studding at each side of the window and at right angles to it at a convenient height two pieces of wood 1 x 12 x 12 inches were firmly nailed, thus forming two brackets Two pieces of straight 2 x ¼ inch flat iron, long enough to go across these brackets, were found, also two straight pieces of 1 x 1 inch iron (discarded square-bed carriage axles with stubs off) The latter pieces were faced with the flat iron by means of a couple of countersunk head stove bolts Two pieces of 2 x 2-inch angle iron would have done as well These made the two jaws of the vise and they were placed across brackets in front of the window, with a wooden strip between the inside jaw and the studding to take the file thrust. On the inner side of each bracket a lever of 1¼-inch square hardwood was pivoted with its upper end bearing against the outer jaw. Two circles of wood were cut and mounted on bolts in the brackets, but an inch off center, so that they could be used as cams to press against the lower ends of the lever and force the upper ends firmly against the outer jaw, thus clamping the saw firmly in place. A handle was secured to each cam, with which to tighten and release the vise.



A HOME-MADE SAW VISE.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

HAIR-RIBBON PIN.—W. M. YEOMANS, Hancock, N. Y. In this case the object of the inventor is to provide a new and improved hair ribbon pin, more especially designed for use on women's hair to securely hold a hair ribbon, to display the bow thereof to the greatest advantage and to give the pin a buckle appearance.

Electrical Devices.

PROCESS FOR OXIDIZING ATMOSPHERIC NITROGEN BY ELECTRICITY.—D. HELBIG, Rome, Italy. This invention consists in employing an electric high pressure flame arc blown in a special manner by means of air for the purpose of oxidizing atmospheric nitrogen. The quantity of energy which becomes effective every moment, remains practically constant.

TELEGRAPH REPEATER.—E. LONGORIA, Monterey, Mexico. When one side of the repeater is working, vibrations are not produced on the reverse side, because the repeating contacts are arranged in such a manner that long before the first one opens the second is closed. Its work is safe and precise as the closing of contacts are made through the use of independent springs for each of them, and they have a uniform tension. It works with less local battery than any system, as the force produced by this latter is not used to close the contacts, and to open them the pressure of the natural weight of the arm of the repeater is almost sufficient, and thus the sound is clear and sonorous.

ELECTRICALLY-OPERATED PRICE-CARD.—P. L. DIBBINO, Spokane, Wash. The invention relates to signs, the more particular object being to produce an electrically-operated price card of simple construction. The effect upon the eye is simply that one legend, together with the light for exhibiting it, disappears, and that the other legend, accompanied by the light for exhibiting it, makes its appearance, the legend thus being presented alternately to the gaze of the observer.

Of Interest to Farmers.

CULTIVATOR.—A. HEIMLINGER, Hanover, Kan. This invention relates more particularly to a form of disk cultivator. The patentee has provided a very simple and light construction of frame and cultivator supporting members which afford a very wide range of various adjustments to position the cultivators to adapt the implement to the particular work in hand.

STACKER.—W. T. MCCALL and D. L. ORENDORFF, Manhattan, Kan. The device is for use in the field for elevating and piling up hay or grain into stacks and primarily for the purpose of stacking grain which has been cut by a header in which the heads of grain with a small proportion of the straw are received into a box-like receptacle and is elevated to pile the same in suitable stacks.

Of General Interest.

LUNCH BOX.—P. J. BIRD, New York, N. Y. The invention refers to improvements more particularly to that type of portable lunch boxes in which separate food drawers or compartments and a separate liquid receptacle are provided, together with means for heating the liquid receptacle and if desired certain of said food compartments.

FOLDING BOX.—C. F. WERNSHALL, Owen Sound, Ontario, Canada. In the present patent the invention is an improvement in folding or knock-down boxes whose sides and ends are hinged together or otherwise so connected as to lie parallel when folded. The box is well adapted for various uses and may be constructed in any size required.

REVOLVING SIGN.—M. HEIM, New York, N. Y. This device may be set and kept in motion by very light currents of air. The bearings are constructed to develop no appreciable friction either at first or after the sign has been in use and exposed to the weather for an extended period. The tendency of the sign to revolve is increased by providing each of its heads, or its opposite ends, with outwardly extending vanes which incidentally add to the ornamental appearance of the sign.

SOUVENIR.—E. C. RICHMOND, Tacoma, Wash. The souvenir consists of a body having the opposite side faces inclining inwardly from each end toward the transverse center and having the edges scored to simulate a package of shingles, the representation being further perfected by placing cross-bars at opposite sides of the contracted central portion of the body, joining the adjacent ends of the bars by metallic straps and nailing the overlapping ends of the straps and bars to the body.

NON-REFILLABLE BOTTLE.—T. W. LEONARD, Richmond, Va. The construction preserves the appearance of the bottle and strengthens the bottle neck where desired. The bottle can be easily filled and sealed and while the dispensing of the contents can be readily accomplished, the sealing devices being adapted to move from sealing to unsealed position for such purpose.

SAFETY WATCH-GUARD.—L. FRIEDMAN, New York, N. Y. The invention relates to certain improvements in that type of devices adapted for securing a watch chain or fob to a watch, and at the same time fastening the watch to the edge of a pocket or other portion of a garment, so that the watch cannot accidentally fall out or be surreptitiously extracted.

Hardware.

CLAMP.—T. NEWTON and H. JOURDAN, Camden, N. J. The clamp is for leather and other goods in which a member is provided with a flange at one end and arms to which are pivoted a movable member having a flange which is adapted to engage the flange on the first-named member, there being shoulders on the pivoted member against which a spring presses to hold the pivoted member firmly in an open or closed position, the spring being secured to the first named member.

HINGE.—H. E. HOKE, Hanover, Pa. The inventor's object is to provide a hinge more especially designed for use on either the right or left shutter and arranged to permit convenient hanging of the shutter, to prevent the shutter from falling off on an upward pull when closing the shutter, and to hold it against accidental closing when in an open position.

LOCK FOR SLIDING DOORS.—J. A. BENEDICT, New York, N. Y. The invention comprehends a plate mounted upon a movable door and sunken thereinto, the plate being provided with a pivotally mounted bolt for engaging the plate by entering the recess thereof, the arrangement of the parts being such that the swinging plate may be swung back into a normal position of inactivity or may be temporarily secured relatively to the plate in the movable door member.

Heating and Lighting.

OIL-BURNER.—W. S. ROBINSON, Fresno, Cal. The invention relates to oil burners adapted for use in cooking stoves, heating stoves or for any or all other purposes where oil is used as a fuel for generating heat. The special object is to provide means for vaporizing the oil and means for controlling the draft of air to the burner.

Household Utilities.

WINDOW FIXTURE.—A. F. GIROUARD, Leominster, and F. A. PERRON, Fitchburg, Mass. The object of the invention is to provide a fixture combining means for supporting or holding a curtain pole, shade roller and blind, the fixture being easily applied to the window casing without the use of nails, screws or other similar fastening devices.

BOILER-STAND.—S. S. STAHL, Connellsville, Pa. The object in this case is to provide an adjustable stand which may be varied to receive boilers of different diameters and also varied in height so as to support such boilers at a proper distance from the floor in order to make connections with the heating apparatus.

COMBINED TABLE AND LAMP STAND.—M. F. KOCH and M. KOCH, New York, N. Y. This invention has in view a combined table and lamp stand such as may be easily moved from place to place and support articles accessible from a bed, chair or other convenient position, the lamp being adjustable over the table to direct the light to any required point.

CONVERTIBLE BED AND MATTRESS THEREFOR.—L. B. JEFFCOTT, New York, N. Y. The object here is to provide a bed and mattress arranged to permit of conveniently converting the bed to form a davenport, a single bed, a double bed or a couch, the mattress conforming to the changes thus requiring no separate mattress for the different forms in which the bed is used.

FOLDING BED.—L. B. JEFFCOTT, New York, N. Y. The inventor provides a two-unit folding bed or couch arranged to permit of collapsing one bed unit and passing it under the other bed unit in such a manner that the mattress, blankets, bed clothes, pillows and other bedding of the collapsed bed unit remain undisturbed and are accommodated in the space between the extended and the collapsed bed unit.

FOLDING BED.—J. RANKO, New York, N. Y. The invention includes a special form of support for the mattress, the support being resiliently carried by the frame. An object is to provide a folding bed frame which when extended forms a comfortable couch or cot, and which can be folded into compact form so that it can be easily moved from place to place, shipped or stored.

Machines and Mechanical Devices.

MOTOR.—A. P. BARNES and O. SCHMITT, Bolckow, Mo. The aim in this invention is to provide a motor with twin escapement wheels which are engaged by pallets mounted on pallet arms, the arms being pivoted to a rocking head and being adapted to rest against the peripheries of the escapement wheels so that the pallets will be lifted from recesses in the escapement wheels periodically during the operation of the motor by the contact of the arms with the wheels at increasing distances from the pallets.

SOUND-REPRODUCER.—B. B. SMITH, New York, N. Y. Of the many purposes of this invention, one is the provision of means to increase the sensitiveness of the stylus lever as regards its movement toward and from the general position occupied by the diaphragm, another is to provide means to enable the stylus lever to be played with various records having different types of sound grooves by merely throwing one jewel or record point out of service and another into service, both jewels being permanently carried by the stylus lever.

FILTERING-MACHINE.—R. T. WILDER, El Paso, Texas. The invention relates more particularly to such machines as operate centrifugally to force the substance to be filtered through the filtering media. An object is to provide a machine having a rotatable casing and a helical screw adapted to centrifugally separate the solid matter from the liquids in which it is held in mechanical suspension.

TYPE-BAR.—L. F. TALIAFERRO, Colorado Springs, Colo. The invention relates more particularly to type bars used in connection with writing machines and the like. One of the objects is to provide a type bar for producing a plurality of original duplicate impressions by a single movement of the bar.

ANIMAL TRAP.—J. SNOW, Falun, Minn. This trap has an open bottom permitting an animal to put its foot clean through the trap so that the trap will become fastened well above the foot. The trap will throw its jaws up the leg of the animal some distance, making it impossible for the animal to escape by chewing away its foot, which is often the case with the old style trap.

STAND FOR GRINDING-WHEELS.—C. I. SOLES, Kankakee, Ill. The purpose here is to provide details of construction for a machine which will enable the instant arrest of motion of its grinding wheels and a resumption of rapid rotary motion therefor as may be desired, the improvement dispensing with the employment of a countershaft and change wheels as well as shifting gear therefor usually provided for each machine.

PIPE-REAMER.—W. F. PORTER, Duke Center, Pa. This improvement is in the nature of a novel construction of pipe reamer for reaming out the ends of pipes or tubing, such for instance as oil well tubing, and it consists in the novel construction and arrangement of parts whereby a reamer is provided which is adapted to ream out tubes or pipes of varying diameters.

POWER SCOOP.—J. P. LORCH, New York, N. Y. An object of this inventor is to provide improvements whereby if the scoop in advancing should meet an obstruction such as a projecting manhole cover or the like, it may slide backward and in doing so reach a higher level and pass over the obstruction, the scoop being immediately returned to its original position by means of a compressed elastic medium or member.

ABSORPTION REFRIGERATING MACHINE.—T. J. KIRK, Louisville, Ky. The device, while freeing the ammonia gas from the moisture contained therein and returning the latter to the generator, acts at the same time as an economizer of heat by preheating the aqua ammonia before it is returned to the generator, so that the latter is raised to a considerable temperature and therefore does not require the same amount of heat to drive off its ammonia that it otherwise would.

Railways and Their Accessories.

WAY BILL.—F. H. [illegible], Los Angeles, Cal. One purpose of the invention is to provide an interline way bill having coupons similar to a passage ticket which furnishes each road over which the freight passes with sufficient information to enable it to provide the proper revenue accruing from the service performed.

TORPEDO.—F. L. S. ANDREWS, West Windham, N. H. The invention comprises a plate which forms a saddle or seat upon the head of the rail to which there is attached a receptacle for an explosive. This receptacle is in the form of a flattened tube and the object is to arrange the latter so that the pressure of the wheel which discharges the torpedo will hold the ends of the tube closed. In this way the bursting of the receptacle by the force of the explosion is insured and also a loud report.

RAILROAD-TIE.—J. A. MCCORMICK and F. F. THRASHER, Cumberland, Md. The improvement pertains to railroad ties and more particularly to ties each comprising a body and pivoted end sections arranged to swing into longitudinal alinement with the body and like the latter having lips adapted to engage rail bases to clamp the rails in position.

BOX-FREIGHT CAR DOOR.—G. W. LAUMAN, Berwick, Pa. The object here is to provide box freight cars, also barns, carriage houses and other inclosures with an improved door adapted to slide parallel to the side of the car or other structure and to swing into the doorway thereof so as to lie flush with the adjoining sides of the same and to be locked thereto.

NUT LOCK.—E. M. LOVETT, Stanberry, Mo. This invention of this patentee is the result of an effort to practically improve the nut lock devices intended mainly for preventing the loosening of nuts in railroad joints. The patent discloses a plurality of washers of special construction, the inner one of which receives the nut and is locked with the outer washer, the latter in turn being so disposed in relation to the fish plate and rail that the whole is held against turning until purposely released.

CAR FENDER.—H. FAJANS and A. M. CHAMBERS, New York, N. Y. The fender consists of a fender frame, an upright frame, arms adjustably and pivotally supported at their inner ends from the car and at their outer ends pivotally supporting the fender frame intermediate its length and having a sliding connection therewith, a slide carried by the upright frame and not connected to the forward part of the fender frame and to the slide, means to hold the outer end above the ground and swing to the ground when it strikes an object received in the net, and means to automatically lock the inner portion of the fender frame in its upper position.

MINE CAR.—T. W. WEAVER and C. B. WEAVER, Hamilton, W. Va. The aim in this case is to provide a device which will securely lock the end gate of a car and which will be automatically released when the car has reached a predetermined point so that the contents of the car will be easily discharged.

Pertaining to Recreation.

PLEASURE RAILWAY.—W. I. MANGELS, New York, N. Y. The railway is for use in pleasure resorts and the like, and is arranged to enable the passengers on a vehicle to assist in propelling the power-driven vehicle, thus providing an exhilarating and healthy ride, and permitting several vehicles driven uniformly by power to race, the hand power supplied by the passengers being the determining factor of the race.

AQUATIC MERRY-GO-ROUND.—H. F. RIEHL, New York, N. Y. The object of the inventor is to provide a merry-go-round arranged to afford an exceedingly novel and highly interesting ride. The passengers in a car undergo several movements, that is, are carried bodily around with the platform, are moved up and down and turn alternately with the car around in opposite directions.

Pertaining to Vehicles.

TIRE PATCH.—J. A. WHEELER, Onaway, Mich. An object of this invention is to provide a device by which the worn outer surface of a rubber tire may be protected and which may be readily applied without the necessity of special tools. A further object is to provide an emergency patch which may be cheaply made from old tires which have been discarded.

DRAFT-EQUALIZER.—F. COOK, Portland, Maine. The equalizer is adapted to be detachably connected to vehicles, plows, etc., and having a double tree adapted to rock on a block with which it engages at opposite sides when thrown to reverse angular positions, and at the center when moved to an equalized position, the block and tree further having V-shaped or other engaging stop portions at the rear of the block, and the block having a rearwardly extending hook for detachably applying it to certain forms of appliances.

DESIGN FOR A CUT-GLASS DISH.—R. H. LITTMAN, Honesdale, Pa. In this ornamental design for a cut-glass dish the form of the dish is circular and the ornamentation simply comprises a cluster of three flowers and their leaves in the center or base of the plate and the same type of flower running around the rim.

BICYCLE.—I. DI TANNO, Philadelphia, Pa. In this the inventor shows a very interesting form of actuating device and structural features of a bicycle, the improvements more practically relating to means for mounting the cranks and the arrangement of clutches coöperating with the cranks to control the actuating sprocket wheel.

TIRE.—F. C. RAYMOND, New York, N. Y. The object of the present invention is to provide a tire arranged to permit of quickly disconnecting the tire from the rim of the wheel for repairs or other purposes and replacing the tire and securely locking it in place on the rim. It relates to tires such as shown and described in Letters Patent of the U. S. formerly granted to Mr. Raymond.

HITCHING DEVICE.—H. A. WITTSTEIN, Hazleton, Pa. The invention relates to hitching devices for use in connection with horses. The object of the invention is to provide an improved device for supporting and retaining a hitching weight and for connecting the same to a bit or reins of a horse. It provides means for engaging the hitching rein or rope to prevent tension so as not to induce backing up.

ATTACHMENT FOR DOUBLETREES.—J. T. ATTER, Remington, Ind., and C. A. FISHER, Clarksville, Ark. The purpose of this invention is to enable the double tree for applying draft force to a load to be positioned at a proper distance from its longitudinal center in engagement with the load and thus by the leverage afforded at one end of the double tree even the load to be drawn, if a strong horse or team is hitched to the shorter arm of the double tree and a weaker horse or team is connected with the longer arm thereof.

Designs.

DESIGN FOR A BADGE.—A. F. PARKER, Brooklyn, N. Y. The design in this case represents a badge comprising an ornamental and symmetrical arrangement of a horseshoe, three clover leaves, and a swastika.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Inquiry No. 8908. For a dealer in tapes and cords for Venetian blinds.

FOR SALE or on royalty, U. S. patent No. 908,845. Lift strap for recumbent patients. Address R., Box 771, N. Y.

Inquiry No. 8918. For manufacturers of "Wydts Electro-Catalytic Sparking Plug."

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FOR SALE.—Specialty for manufacturers. Dental floss holder patented May 1908. For further particulars apply direct to inventor, T. A. Tobin, Seattle, Wash., care H. S. Emerson Company.

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Inquiry No. 8928. For the manufacturers of a steam rotary excavator as described in the Scientific American of December 1, 1908, page 347.

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PARTNER WANTED with small capital to promote several patents. L. Feldra, 89 Congress St., Jersey City.

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Inquiry No. 8966. Wanted the address of the Cohendet Motor Co.

Inquiry No. 8969. Wanted machines that make accordion dress plaiting (steam).

Inquiry No. 8971. For address of firms interested in fishing reels.

Inquiry No. 8972. For manufacturers of machinery for manufacturing denatured alcohol.

Inquiry No. 8978. Wanted the address of manufacturers of dry pans or crushers to grind sand for plastering and cement works.

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Inquiry No. 9003. For the address of parties who make "Invar" or other metals having a low coefficient of expansion.

Notes and Queries.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions, books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of March 18th or will be sent by mail on request.

(12111) C. B. says: Will you kindly inform me as to the principle of the electrolytic detector used in wireless telegraphy? A. If an electrolytic detector has a small electromotive force applied to it by a shunted cell of battery, the electrodes become polarized and the current is reduced practically to zero. When oscillations are sent through the cell in this condition they destroy the polarization of the small electrode and the current suddenly increases, but it returns to its former small value when the oscillations cease. This explanation, with a full discussion of the subject, you may find in Fleming's "Elementary Radio-telegraphy and Radio-telephony," which we send for $2.

(12112) T. F. Van W. says: Can you tell me if the specific gravity of the moon is known, and if so, how it compares with that of the earth? A. The density of the moon is 0.61 that of the earth. One of the best determinations of the density of the earth is 5.527, reached by Boys in 1894. This would make the specific gravity of the moon to be 3.37.

(12113) C. S. says: 1. If we take two jars of equal inside diameter and fill both with equal quantities of alcohol and leave one jar open, but close the other with a cover with only a small opening through which the vapor can escape, will the alcohol evaporate in the same time from both jars, all other conditions being equal? A. The evaporation of any liquid takes place more slowly out of a bottle with a small mouth than out of one with a large mouth. 2. Does reflected sunlight differ in any way from direct sunlight? That is, will a plant grow as well if exposed to reflected as to direct sunlight, and will reflected light kill certain bacteria as well and quickly as direct sunlight? A. Ordinarily reflected light differs in no respect from the same light before reflection. The spectrum of moonlight is simply a fainter spectrum of sunlight. Any effect which direct light can produce will be produced by reflected light, except for the loss in brightness by reflection. 3. Does sunlight lose in intensity if reflected by a clear mirror? A. There is no perfect reflector. Light is lost by reflecting it from any mirror whatever. A metal mirror will reflect about 6/10 of the light which strikes it perpendicularly, and a mercury mirror about 75/100. The loss is larger if the light strikes the mirror obliquely.

(12114) R. I. T. asks: On April 22nd the A Z's, a club of six young men, held a spirited meeting at the home of one of its members. The topic under discussion was: Resolved that if a tree falls in the forest and there is no animate being present there is no sound. After the discussion the judges awarded their decision to the negative, merely on the merits of the debate, however, not on the merits of the question. Not being satisfied on the merits of the question, however, as brought out in the material presented, the club would like to ask that you answer it in your paper. A. The answer to your question depends upon the definition of the word "sound" applied to the argument. In most dictionaries two definitions are given: 1. A sensation produced through the organs of hearing. In this sense if there are no human or animal brains present to receive this sensation through the organs of hearing, there is no sound. 2. The physical causes of such sensation, waves of alternate compression and rarefaction passing through any substance, solid, liquid, or gaseous, but especially through the atmosphere. The sound waves are produced by the fall of the tree, whether or not there are organs of hearing present to receive them, and consequently in this sense sound is made though unheard.

(12115) J. R. D. says: May I ask your opinion re the following? What is the correct size and length of stove pipe to give a strong draft to a stove of the following dimensions? Diameter 6 feet, height to top of stove 3 feet, beyond that height a sloping dome about 4 feet, terminating in a stove pipe. At present I have a 10-inch stove pipe about 12 feet long. Draft below is supplied by leaving open the irregularities in the ground. The stove is intended to aid in burning out stumps, the idea being to bore and light the stump in the usual way and then place the stove over it to give a strong draft and suction, so that the roots as well as the stump would burn clean out. At present, with the stove pipe as mentioned, it does not appear to make much difference, nor make the bored stump burn any longer than without it. Is the stove pipe too small for such dimensions? If properly proportioned, even if not successful in burning out the roots, it should make a very fierce fire by the draft and suction, which is not the case. A. We should not say that the dimensions of your stove pipe could be usefully increased, or that combustion of the stumps would be more complete if the draft were increased. If we correctly understand your method of burning the stumps, a stage must be reached at which combustion can only be from the inside outward, especially when nearing the roots, after which the flame would have to travel against the draft, and the latter would be unlikely to help it. Such a method of destroying stumps must be slow at the best, as a block of solid wood would soon be covered with ash and consumed material, leaving no inflammable surface exposed to the flames.

NEW BOOKS, ETC.

Fish Stories. By Charles F. Holder and David Starr Jordan. New York: Henry Holt & Co., 1909. 336 pages. Price, $1.75 net.

Prof. C. F. Holder is one of the oldest contributors to the Scientific American, and he is well known to our readers. Prof. David Starr Jordan is president of Stanford University and is a well-known ichthyologist. The authors are perhaps two of the most prominent amateur and professional students of fish in the country, and this volume tells their unusual fish exploits and their best fish stories. It is a delightful miscellany, telling about the strangest kind of fish with a strictly scientific description which melts almost imperceptibly into accounts of personal adventure. Unlike most fish stories they have a strong foundation in fact. It is a book which we can commend to the general reader as well as those who are slaves of the rod.

Characters and Events of Roman History from Caesar to Nero. By Guglielmo Ferrero. New York: G. P. Putnam's Sons, 1909. 8vo., 275 pages. Price, $2.50 net.

The present work, which is very handsomely printed and bound, consists of a series of studies of the great men and great women of ancient Rome and critical moments and events in Roman history. Among the people and subjects treated are: Corruption in Roman History, the Legend of Antony and Cleopatra, Nero, the Relation of the Conquest of Gaul to the Development of Modern France, Julia and Tiberius, Wine in Roman History, and Roman History and Modern Education. Interesting, entertaining, picturesque, full of pregnant ideas, this volume of Prof. Ferrero's is sure to find an absorbed audience that will be richly rewarded for the close attention they will give it.

Birds of the World. A Popular Account. By Frank H. Knowlton, Ph.D. With a chapter on the Anatomy of Birds by Prof. Frederick A. Lucas. The whole edited by Root Ridgeway. New York: Henry Holt & Co., 1909. Quarto, 872 pages, 16 colored plates, 236 illustrations. Price, $7.

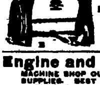
There has been a great popular awakening in recent years in relation to our birds. It is only necessary to pay a visit to the American Museum of Natural History in New York to see evidences of the growth of this movement. The magnificent exhibits which are to be found in this building have done much to awaken interest in birds, as has also the work of the Audubon societi. The widespread nature teaching in our schools is also responsible for the increased interest in ornithology. Few of those who turn to the country either for recreation or for permanent residence have an inclination or desire to become professional ornithologists, but they have wished to know at least the names and facts in the life history of the birds that they see constantly about them. To supply this demand for popular information a large number of works have been written, and their extensive circulation proves that they have filled a real want; but most of these are more or less local in their scope, only a few treating of the birds of the whole world, so that the time seems ripe for a work of moderate size in a single volume which would set forth in non-technical language the salient facts regarding the birds of the world. The author has attempted to prepare such a work, and he has succeeded admirably in his task. The illustrations are excellent and numerous. The colored plates are well executed. It is a book which should be in every library as well as in every school library. The book is a portly one and is handsomely bound.

Mendelism. By R. C. Punnett. American Edition, with Preface by Gaylord Wilshire. New York: Wilshire Book Company, 1909.

This is the second edition of a popular work on Mendelism which has won for itself a deservedly high place in current popular scientific literature. Why Mr. Wilshire should have burdened the book with a Socialistic Preface is more than we can understand. It is a far cry from Mendelism to Socialism.

Les Planètes et leur Origine. By Ch. André. Paris: Gauthier-Villars, 1909. 285 pp. Price, 8 francs.

M. André's book is divided into three parts, in which the planets, satellites, and the formation of the planetary system respectively are described. Among the striking features of the



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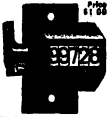

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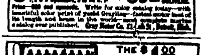

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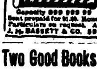

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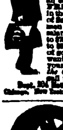

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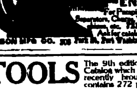

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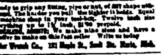

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book may be mentioned the author's arguments in favor of the rotation of Mercury and Venus, excellent résumé of Poynting's temperature investigations, his summary of the evidence against the canals of Mars, and a fine chapter on minor planets. The division on satellites discusses the various announcements of a satellite of Venus, the Martian satellites, and the recently discovered satellites of Jupiter. The Laplace system and its inconsistencies are excellently discussed in the last division.

Crude Rubber and Compounding Ingredients. A Text Book of Rubber Manufacture. By Henry C. Pearson, Editor of The India Rubber World. Second Edition. New York: The India Rubber Publishing Company, 1909.

This is the second edition of a book which appeared ten years ago and which may be regarded as a standard work on the subject in English. Since the appearance of the first edition the rubber industry has made rapid strides. New sources of rubber have been opened up and progress has been made in reclaiming waste rubber. In this revised edition the improvements in the art have all been conscientiously noted. The many new compounding ingredients, substitutes and processes find a place in its pages. As it stands the book is a dictionary of compounding facts and an encyclopedia of rubber factory practice, intended primarily for factory use.

Atlas und Lehrbuch der Hygiene. Mit besonderer Berücksichtigung der Städte-Hygiene. Herausgegeben von Professor Dr. W. Prausnitz, Vorstand des hygienischen Instituts der Universität Graz. München: J. F. Lehmann's Verlag, 1909.

The science of hygiene is concerned with the preservation of the health of human beings. Its study is based upon an accurate knowledge of the human organism and the effect of environment upon that organism. Hygiene is either scientific or practical. Scientific hygiene endeavors to ascertain everything that may have an effect upon health and to determine the conditions which are most favorable for the development of mankind. Practical hygiene has for its object to apply the principles which have thus been scientifically discovered so as to reduce the dangers to human health. In order to attain this object, practical hygiene requires innumerable technical installations which include not only the construction of a dwelling but everything that pertains to a dwelling. Unfortunately this ideal has not as yet been reached because the engineer and the physician have not worked in perfect accord and also because the landholder is only too frequently prompted to build his structures as cheaply as possible. It is the purpose of the work before us to set forth these principles of hygiene simply and clearly and yet accurately so that the public will acquire a broader knowledge of the development of a new and important science. The book is intended not only to help the architect who draws the plans of the house and the builder upon whom devolves the duty of construction but it will serve the purpose of indicating to the factory or house owner what he owes his employees or the inmates of his house. The book will also aid the client of the sanitary engineer to point out definitely just what he wants. Hitherto he has been able to talk only vaguely because he had no concrete example to which he could point.

Unsere Honigbiene. Von Prof. K. Sajó. Stuttgart: Kosmos Gesellschaft der Naturfreunde. Price, 50 cents.

Prof. Sajó is a well known contributor on natural and scientific topics, not only to Kosmos but to other periodicals as well. In this little book he has given a very clear and comprehensive description of the bee as a biological species and also as a useful insect.

The Art of the Netherland Galleries. By David C. Preyer. Boston: L. C. Page & Co., 1908. 12mo., 380 pp. Price $2.

This attractive volume is one of the series of the Art Galleries of Europe of which seven have already been published prior to the present volume which is the history of the Dutch School illuminated and demonstrated by critical descriptions of great paintings in the many galleries. The wonderful and unique art of the Dutch School of the seventeenth century can nowhere be studied so completely as in the Netherland galleries. Any work which tends to bring these masterpieces into closer touch with the visitor should be warmly welcomed. The present volume is a painstaking appreciation of the art of the great masters of Holland. The book is exceedingly well written and the illustrations reproduced in sepia tints are very much better than in the average work. The paper is particularly light in weight and the book will be found a most enjoyable one for those who are fortunate enough to be able to visit the galleries in person while to those who stay at home the book will prove of genuine interest. It is most attractively bound.

The Resuscitation of Persons Shocked by Electricity. By Edw. Anthony Spitzka, M.D., Professor of General Anatomy, Jefferson Medical College, Philadelphia, 1909. Reprint from the Journal of the Medical Society of New Jersey.

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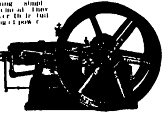

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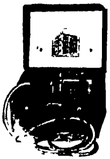

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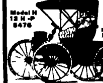

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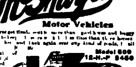

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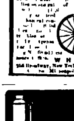

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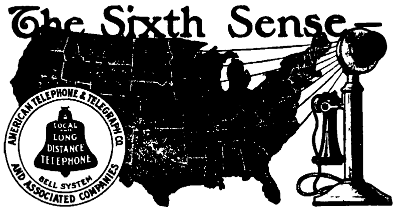

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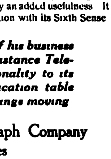

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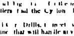

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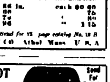

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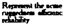

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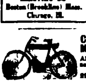

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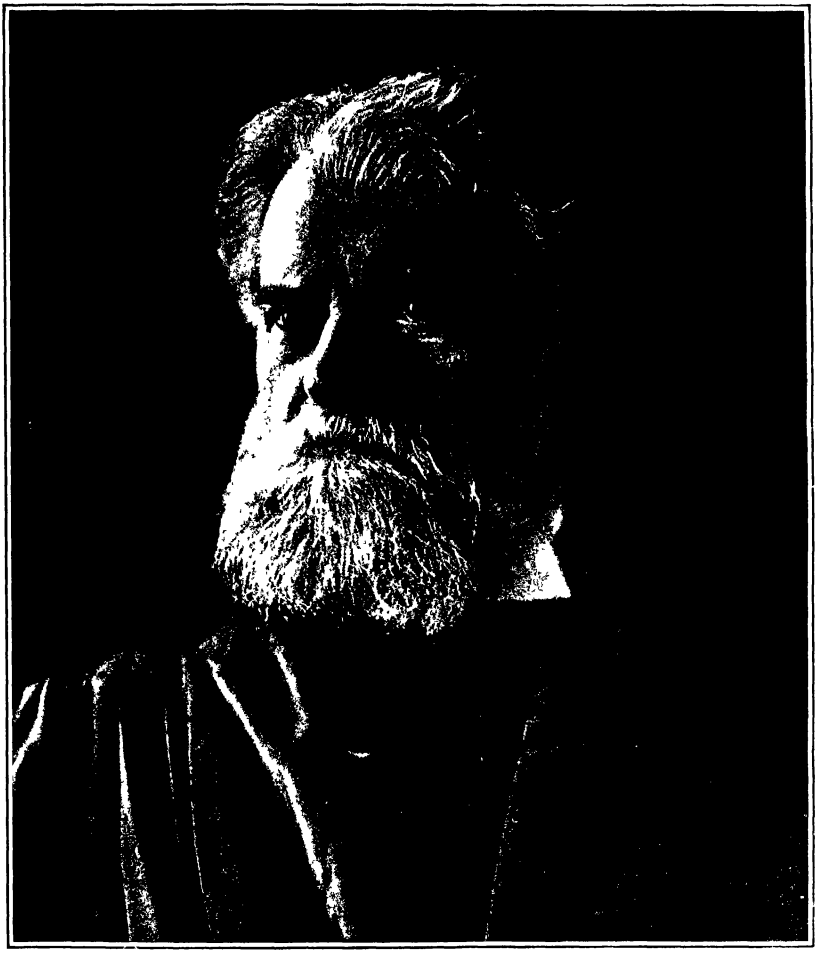

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NEW YORK SATURDAY JULY 24th 1909

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest If the photographs are sharp the articles short, and the facts authentic the contributions will receive special attention Accepted articles will be paid for at regular space rates

CITY TERMINALS WITHOUT TRAFFIC CONNECTION.

The total lack of a co-ordinated plan (or shall we say of coordination of effort?) in the provision of transportation facilities in New York city is forcibly brought to the notice of the public by a letter of Vice President Rea of the Pennsylvania Railroad Company to Chairman Willcox of the Public Service Commission which draws attention to the fact that when the Pennsylvania's new station at Seventh Avenue and 33rd Street New York is opened to the public in the summer of 1910 it will be without any connection with the rapid transit system of the city

The predicament in which the magnificent new terminal will find itself has its parallel in the history of the three great bridges across the East River The Williamsburg Bridge stood for several years after its completion completely isolated from the elevated railroad systems of Manhattan and Brooklyn and it was only recently that the costly elevated approaches to and roadways on the bridge were placed in service The great Queensboro Bridge opened a few months ago is likewise without any rapid transit or elevated railway connections and the present indications are that the new Manhattan Suspension Bridge which will be completed within a year will find itself in the same predicament The case of the new Pennsylvania terminal will be particularly aggravated, since it will not only bring all the express trains of America's greatest railroad into the city but it will also serve as the gathering and distributing center for a large suburban travel from New Jersey and from the extensive and populous residential districts of Long Island

Obviously the most satisfactory plan for placing the Pennsylvania terminal in immediate touch with the subway system would be to build an extension of the existing subway south from 42nd Street through Seventh Avenue to the Battery This is the plan advocated by the Pennsylvania Company and as far back as 1906 such a route was laid out by the old Rapid Transit Commission as part of a complete system through Manhattan and the Bronx the northerly portion of which was to be built up Lexington Avenue from 42nd Street to provide the east side with greatly needed facilities This route is indorsed by the present Public Service Commission The failure to build the line must be laid at the door of the Interborough Company which operates the present subway for it was not until last June that the offer of this company to construct such a line was received by the Commission who have the proposal now under consideration The traveling public has no interest in the controversy as to where lies the responsibility for the delay but it is tremendously interested in having this line constructed with the least possible delay We are well aware that there are other rapid transit routes before the Commission for each of which their particular sponsors claim special advantages and the necessity for immediate construction but in view of the importance of the new Pennsylvania terminal as a distributing center and of the pressing need for another four track line south from 42nd Street to the Battery we believe it will be the consensus of opinion that this line should be one of the first if not the very first to be authorized and that the contractors and the Public Service Commission should join hands in rushing it to an early completion

MAGNITUDE OF WORK ON NEW STATE BARGE CANAL

The stupendous engineering work which the United States government is carrying through at the Isthmus of Panama so completely fills the public eye that very little is heard of that other great work of canal construction which is being executed in our very midst in the enlargement and reconstruction of the old Erie Canal between Buffalo and Albany. Certainly but few people outside of professional circles are aware that in point of magnitude of excavation the figures for the New York State Barge Canal rival, if they do not exceed, those of the Panama Canal. Admitting that there can be no comparison on the score of accommodations between a canal twelve feet in depth and one with a maximum depth of forty five feet it should not be forgotten that whereas the Panama Canal from shore line to shore line is but forty miles in length the New York Barge Canal extends for nearly four hundred miles Furthermore, the latter work involves the construction of thirty four dams fifty three locks and seven guard locks the construction of which is complicated by the fact that the canal being built through the most thickly populated section of New York State the effect of these works on adjoining properties and water powers has to be considered and due precautions against damage taken, involving additional costs in time and labor

It is in the comparison of the amount of excavation done however that the surprising fact is developed that the total amount of excavation and its equivalent in concrete structures if compared for the same period of time is found to be actually greater on the State Canal than on the national undertaking at Panama Up to January 1st 1909 the excavation on the Barge Canal amounted to 15 168 000 cubic yards and if to this be added the concrete and other constructional work the total cost up to that date reaches $8 701 000 On the Panama Canal, up to January 1st 1908 the total amount of material taken out amounted to 22 2[illegible] 000 cubic yards and up to that time practically no work had been done on the concrete structures It is stated by the engineers that if the sum of money expended during the period under consideration on concrete and other structures on the Barge Canal had been paid for excavation at the prevailing rate it would have been possible to remove an additional 10 417 000 cubic yards of material This would have brought the total of excavation up to 2[illegible] 585 000 cubic yards which would have been equivalent to an increase of twelve per cent over the amount of excavation done on the Panama Canal during the same number of years of operation It is only fair in connection with these figures however, to bear in mind that the present rate of excavation in Panama is far more rapid than that on the State Barge Canal This however does not invalidate the force of the above comparison as showing the magnitude of the work now being done between Buffalo and Albany It is greatly to be regretted that the canal enlargement was not planned on a more generous scale When the canal is opened the depth of twelve feet will appear to be pitifully insufficient in view of the fact that by that time the construction of the new Georgian Bay Canal which will provide a depth of 21 feet from the lakes to deep water on the St Lawrence will in all probability be well under way

WIRE-WOUND VERSUS STEEL GUNS

In these days of big gun ships and long range fighting the gun as one of the offensive elements of naval warfare has taken on an importance greater than it ever held before In the engagements of the future which will be fought at ranges of from four to six miles accuracy of aim and large remaining energies of projectile become of prime importance The most effective big gun for the new conditions will be that which will strike the heaviest possible blow, at the greatest possible range with the lightest possible shell fired from the lightest possible gun These ideal results which can be obtained only in a gun of unusual strength for its weight involve high powder pressures great length of gun, exceedingly high muzzle velocity and a temperature of the powder gases so high that it will necessarily induce rapid erosion Abnormal powder pressures must be met either by using more material in the gun or by the use of steel of exceedingly high quality as to strength and toughness or by some mechanical arrangement in the building up of the gun, which will secure the needed strength with a minimum amount of weight

Never was it more true than to-day that the battles of the future will be won by the big gun If the ten or twelve great pieces mounted in their several turrets are unable to fire their eighty or one hundred rounds apiece with accuracy and without diminution of energy, if there be an unusually rapid erosion, if they show longitudinal weakness and begin to droop at the muzzle or if as has often happened in the past the muzzle and chase of the gun are blown bodily away the ship that carries those guns will go down to a sure and terrible defeat Unable to reach the enemy because of the failing velocity of her own guns she will continue to be subject to the pitiless accuracy and armor-piercing energy of the enemy's shells, and the unequal combat can have but one issue

There are two leading systems of gun construction, the wire-wound system, which is used by Great Britain and Japan, and the solid-steel system, which is used by all of the other leading naval powers, including our own At the time the wire-wound system was adopted by the British, gun steel for hooped gun construction had not reached the high pitch of excellence which characterizes it to-day, but with improvements in furnace practice and working in the mills, it has become possible to turn out a quality of steel which the German, French, and American manufacturers claim produces a gun equal, weight for weight, to the wire-wound gun—a gun moreover, which is simpler to build, and in some respects more reliable and less likely to serious injury in an engagement.

In view of the above facts a recent lecture before the Junior Institution of Engineers London by Lieut Dawson in which he goes very thoroughly into the question of the relative merits of wire-wound and solid steel guns, is of timely interest, since it shows why, in spite of the acknowledged improvements in the manufacture of hooped guns, the English artillerists still prefer to build those of the wire-wound type The chief advantage of the latter system, according to Lieut Dawson, is that a uniformity of stress is attainable throughout the whole of the material employed in the gun structure, to an extent that is impossible in a gun built up of steel hoops only Weight for weight the wire-wound gun is the most efficient. The uniformity of stress is due to the fact that the wire is wound on at the theoretical tension necessary to obtain from every layer the maximum resistance when the gun is fired Furthermore, the breaking stress of the wire now used is no less than twice as great as that of the best forged steel available for solid steel construction the breaking stress of gun steel being from 34 to 44 tons to the inch, as against a stress of 90 to 100 tons for the wire By regulating the tension in the successive layers of wire during construction the resisting strength of the steel is obtained to a degree that it is not possible to get by shrinkage Lastly, because of its small cross section the wire is more likely to be free from minor defects, since it can be inspected and tested throughout its complete length. So much for the constructional advantages

In the completed gun there is the advantage that if the inner tube of a wire wound gun fails, it is still possible to continue firing without danger whereas, splitting of the inner tube of a built up gun renders the weapon immediately useless Should a flaw occur in a tube or hoop there is great danger of such flaw extending until complete rupture occurs In a wire-wound gun on the other hand, a rupture in any coil cannot spread to adjacent coils Again should a large explosive shell burst in the bore, the wire construction according to Lieut Dawson, will prevent the explosion doing serious damage to the turret It is possible when a wire-wound gun becomes badly eroded to reline the piece and render it nearly as good as new a feat which is more difficult in solid steel guns The increase in the power of the gun, due to the introduction of the wire wound system and to the vast improvement in the quality of gun steel for hooped guns is shown by the fact that the energy of the British 12 inch gun has risen from 18 200 foot tons in 1895 to 53 045 foot tons in the new 50-caliber gun which will be ready in 1910, while the corresponding penetration of wrought iron at the muzzle of the gun has risen in the same period from 24 5 inches to 52 inches, this last being the muzzle penetration of the new 1910 pattern

BURGLAR-PROOF GLASS.

Consul William Bardel of Rheims reports that a new French plate glass has been brought out which is practically burglar proof While an ordinary plate glass such as is usually put into jewelers' show windows, can be smashed by a single stroke of a metal faced mallet it is not possible to break this new plate glass in this manner In an experiment made, a large piece of cast iron was thrown violently against the window, but the only effect on the glass was a small hole measuring one or two inches. Several shots of a revolver loaded with jacketed bullets were then fired at the show window, but the window suffered no damage except that the bullets entered to a depth of a fraction of an inch. The plate glass which will stand such usage is ordinarily made of a thickness of ¾ to 1 inch If desired, even a heavier glass can be made without diminishing the transparency

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In order to do away with attending to exhausted batteries of door-bell systems a transformer has just been put on the market which enables one to obtain the current from the city mains The transformer will operate on the ordinary lighting circuits. As it has no moving parts, once fixed it will thereafter require no attention It is adapted to operate on circuits running from 100 to 120 volts, and is provided with taps giving 6, 12, and 18 volts, so as to meet the requirements of various styles and sizes of bells and buzzers.

AERONAUTICS.

These members of the Aeronautic Society who have completed and tried out their machines have not met with good luck of late. A week before the exhibition of June 26th Wilbur R. Kimball damaged his eight-propeller biplane by hitting the banked part of the track at one of the turns, and last week Frederick Schneider demolished his Wright-type aeroplane, which was fitted with the society's motor when it was shot off the catapult. Both of these members, nothing daunted, intend to build new machines The Beach-Willard monoplane is nearly completed and will probably be tried by Mr Willard within a few days as soon as he has learned how to fly the Society's new biplane.

Senator Henri Deutsch de la Meurthe, who has probably done more than any other one man to encourage the development of aeronautics by offering generous prizes, has recently given $100 000 for the founding of an aero-technical institute in connection with the Paris University The new institute will be named after M Deutsch, and will be devoted to study and research for the purpose of perfecting flying machines of all types. M. Deutsch has also given $3,000 and the University $2,000 annually to carry on the work M Basil Zakaroff a wealthy Greek resident of Paris, has given $140,000 for the founding of a chair of aviation by the Faculty of Science at the University These two gifts show the generosity not only of the native Frenchman but of the foreigner who has made France his adopted land when the two meet in the common field of science.

The "Zeppelin I"—the German government's first Zeppelin airship—recently made the trip from Friedrichshafen to Metz. The former place was left at 12 27 A. M, June 29th There was a light northwest wind blowing Ravensburg was passed at 1 07 the airship continuing northward at about 18 miles an hour At 4 P M a landing was made in a field at Biberach because of bad weather and trouble with the motors Despite a heavy rain, the crew of eight men brought the huge craft safely to earth A battalion of soldiers was required to hold it the next day when the wind blew a gale Repairs were finally effected and the airship at length reached its destination on July 4th After another of the latest type Zeppelins' is completed for Metz the "Zeppelin I' will be sent to Tegel, near Berlin, as a school ship The official report of the recent long-distance trip of the 'Zeppelin II" will be found in the current SUPPLEMENT

A faint idea was given New Yorkers last week of what a modern dirigible could do in the way of passing over their city, when Frank Goodale sailed his tiny airship from Palisade Park, on the west bank of the Hudson opposite 130th Street, across the river and above Broadway to 42nd Street The craft, under perfect control and making about 12 miles an hour circled around the Times Building and returned to its starting point in 40 minutes. A large modern dirigible, with a speed three times as great and a carrying capacity of a score of passengers, could have made this trip in much less time, even with quite a wind blowing. M Clement, of Paris, is at present constructing just such an airship with the idea of crossing to England Some patriotic British newspapers are constructing a shed for it at Aldershot with the hope that after this craft has demonstrated its capabilities the government will purchase it and thus acquire a large up-to-date dirigible.

Orville Wright, in attempting to fulfill the government requirements at Fort Myer with his aeroplane has met with numerous set backs and a great deal of ill luck Owing to trouble with the motor and unfavorable winds, the first flight consisting of one circuit of the field, was not made until June 29th, and then only at the third attempt The next day the machine flew the length of the field but scraped one end of the lower plane in making the turn, and in landing broke one runner On July 2nd two flights were made of 7 and 12 minutes, the second being terminated by the stopping of the motor when the machine was over the shed at the end of the field In landing one end of the lower plane caught on a small tree, which tore the cloth and whirled the machine around, completely demolishing the runners. Ten days were taken to repair the machine, and it was not until the 12th instant that Orville Wright succeeded in flying again This flight lasted 5 minutes and 38 seconds. The next day the machine failed to rise properly, and but two straight-line jumps of less than half a minute were made, a runner being broken in alighting the second time. Although a large crowd of prominent people visited the parade ground every afternoon last week conditions were generally said to be too unfavorable for a flight, and aviation in the vicinity of the national capital received a sharp set-back as a result of the failure of the Wright machine to fly under what could hardly be called really unfavorable conditions, such as a light wind of 6 or 8 miles an hour for example.

ELECTRICITY.

A large Mexican hydro-electric company has just been organized for the purpose of furnishing the power for a vast irrigation scheme A large plant is to be built near Lake Chapala and another on the Santiago River near Guadalajara The territory which is to be reclaimed by this irrigation system covers more than 500 000 acres.

The success of the electrically illuminated baseball grounds at Cincinnati Ohio has been so pronounced that it is now proposed to have football games, as well, on the illuminated field Football is too strenuous a game to be played under the summer sun but no such objection can be raised to it in the cool of the evening or night. It is expected that quite a number of outdoor sports and games will now be possible for evening entertainment

Last year $56 000 000 was spent by the railroads of the United States for cross ties The average price of the ties was 50 cents each Only six per cent of the ties was used by electric railroads Forty three per cent of the ties were of oak, and nineteen per cent of yellow pine Owing to the growing scarcity of suitable timber other woods are being used after treatment with various preservatives and it has been found that these treated woods outlast the more expensive untreated oak ties.

In a talk given before the Electric Club of Chicago Mr Edward N Lake pointed to the remarkable growth of street railway systems in the United States Of the 8 123 miles of single-track railways in 1890 only 15 5 per cent were operated by electricity At the beginning of last year there were 34 404 miles of street railway, 34 060 miles or 99 per cent of which were electrically operated Mr Lake also pointed to the rapid strides now being made in the electrification of steam railroads and predicted great progress within the next ten years

A new type of electro magnetic brake is being manufactured in Germany which operates on the rails rather than on the car wheels This rail brake comprises a pair of pole shoes which are parallel with the rails and located close to them The braking effect may be increased by lengthening the pole shoes. The weight of the brake is but three per cent of the pressure it exerts The brake is adapted particularly for mountain railroads and may be used in conjunction with an ordinary wheel brake to increase the adhesion of the car to the rails.

Early in June an outdoor theater conducted by the Boston Suburban Electric Railroad at Auburndale-on the-Charles was burned to the ground The fire was discovered at 2 o'clock in the morning but the general manager was on the scene inside of twenty minutes A telephone station was immediately established, and within two hours a designing engineer was on the ground planning a new structure An hour later the carpenters and contractors arrived ready to estimate the cost of reconstruction By this time the ruins were cool enough to permit of starting work which was rushed through with such celerity that within ten days a brand new theater complete in every detail and seating three thousand persons was ready for use Credit for this rapid construction is due almost entirely to the telephone which was in constant use during the ten days of construction

It is well known that Hertzian waves can be transmitted more readily over water than over land The reason for this was explained quite recently by Prof J A Fleming in a popular lecture He showed that a current of high frequency could be transmitted over a galvanized iron wire as readily as by means of a copper wire but that if the zinc was burned off the wire, so that the current had to traverse an iron path there was a considerable reluctance This showed that high frequency currents which normally travel over the surface skin of a wire, will penetrate farther into the metal of low conductivity The Hertzian waves do not penetrate water to a depth of more than a few feet but when traveling over dry soil there is a much greater penetration due to the poorer conductivity which results in a greater loss of energy

An electric railway running from Trient to Malè, Austria, a distance of 38 miles, is soon to be put into operation The current is to be supplied by a hydro-electric plant. This marks an important step in the utilization of water power in the Tyrol Another railway line is nearing completion in Austria, known as the Maria Zell road This line is 57 miles long and is the longest single-phase railway in Europe The current is furnished by a hydro-electric plant, and is fed to the trolley wire at a pressure of 6,000 volts. The catenary system is used for supporting the trolley wires. The locomotives will each be equipped with two single-phase 250-horse-power motors Owing to the narrow gage, the motors cannot be mounted on the car axles, but are situated above the trucks and connected to the wheels by means of connecting rods after the manner of a locomotive.

SCIENCE.

"Orthodentist" is the technical name of a new kind of dentistry In plain English orthodentist means "tooth-straightener According to last accounts, there are about 60 of him now in America, as compared with 50 000 ordinary dentists To the orthodentist's mind a man who extracts a tooth in regulating foolishly clings to old tradition He holds that the properly shaped jaw can hold all the teeth that grow

Mr C E S. Phillips exhibited at the recent *conversazion* of the Royal Society a permanently luminous watch dial and military night compass The watch dial is transparent (glass) and the figures are painted upon its upper surface The dial is backed with a compound containing a minute quantity of $RaBr_2$ (radium bromide) which renders it luminous so that the time may be easily read in the dark The compass is arranged upon the same principle By means of a luminous disk and strip direction may be determined at night

A series of ascents of kites and balloons on Lake Victoria was organized by the Prussian Aeronautical Observatory of Lindenberg in July 1908 A registering balloon which attained the height of 19 8 kilometers recorded at that altitude a temperature of —84 deg C a lower value than has ever been found at equal or even greater altitudes over Europe The isothermal layer was entered on several occasions On several occasions also an uppermost current from the west was found above the regular easterly current of the equatorial region

It was shown by the N S W Royal Commission on the Spontaneous Combustion of Coal Cargoes (1897) that ships whose cargoes took fire had mostly been loaded in summer In view of the high summer temperature of Newcastle N S W, this was only what might have been expected, but it does not seem to have been noticed that a similar relation might obtain for cargoes loaded in the temperate climate of the United Kingdom Prof Threlfall has made an analysis of 4 898 long voyage shipments in the years 1873 1874 and 1875—presented to the English Royal Commission of 1876—which analysis shows unmistakably that it is only cargoes loaded in summer which are liable to spontaneous combustion

A new process of keeping eggs consists in placing them first in compressed carbon dioxide which almost completely sterilizes them and then in a mixture of carbon dioxide and an inert gas (nitrogen and hydrogen) at a temperature near the freezing point In these conditions the micro-organisms which have not been destroyed cannot develop The addition of the inert gas is necessary in order to prevent the liquefaction of the albumen which would certainly occur in an atmosphere of pure carbon dioxide Eggs thus treated can be kept ten months without losing any of their qualities The treatment costs about 38 cents per thousand eggs while cold storage costs 13 cents per thousand per month hence if the eggs are kept nine or ten months the former process will be much cheaper than the other

A French commission formed for the purpose of making comparative studies of the vertical and inclined styles of handwriting with regard to the health of school children has unanimously reported in favor of the inclined style which is asserted to be far simpler and less fatiguing than the vertical style and less likely to cause spinal curvature and other evil results In writing by the vertical system the right arm is held in an unnatural position which makes it impossible for the child to maintain a normal and hygienic posture Vertical writing is performed very slowly and laboriously and may seriously injure children who are predisposed to spinal curvature and other deformities or to writer's cramp The oculist of the commission denies that vertical writing presents any advantage over inclined writing with respect to the prevention of short sightedness

At a meeting of the horticultural society of Algeria, last November a number of seedless dates of large size and fine flavor were shown which had been produced without artificial fertilization The date palm (*Phœnix*) is a diœcious plant the male and female flowers being borne on separate trees No seed can be formed unless pollen is conveyed from the male to the female flower by wind insects or human agency In Algeria pollination is usually assisted by placing a few male flowers with ripe pollen among the female flowers Egyptian paintings show that this method was practised in antiquity Seedless fruits have often been produced by isolated female trees but hitherto these seedless dates have been imperfectly developed At Nice is cultivated a species of date palm which produces black fruit and bears abundantly every year whether the flowers are fertilized or not the seedless dates being equal in size and flavor to the normal fruit In most species however the seedless dates are smaller and are produced less abundantly than the normal fruit.

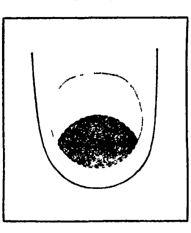
SOME EXPERIMENTS WITH AN ORANGE.

BY PROF GUSTAVE MICHAUD, COSTA RICA STATE COLLEGE

Experimenters in need of chemicals may sometimes do without the druggist. The soil, plants, animals, are but chemical laboratories. In one orange, chemicals are found in such a number and of such a nature as to enable anyone to perform several curious experiments. Most of the readers of the SCIENTIFIC AMERICAN probably have read about or used the sympathetic ink which is obtained by merely dipping a pen into the juice of the fruit. The sudden apparition on the heated paper of the hitherto invisible script is one of the pretty experiments which can be made with orange juice. Those which the writer is about to describe have more to do with the physiological than with the strictly chemical properties of the fruit.

Sugar and a considerable amount of citric acid are found in a ripe orange. Besides the taste, a good proof of the presence of a true acid in orange juice can be had by boiling in water a few red cabbage leaves and then letting some orange juice fall into the bluish decoction. The instantaneous change from blue to red reveals the presence of acids even when taste fails. It may be a matter of surprise to many to learn that the strong sugar and acid flavor of orange juice cannot be perceived by a considerable region of our gustative organ. The middle anterior part of our tongue is as insensible to these two flavors as the *punctum cæcum* of our retina is insensible to light. The fact was ascertained for the first time I believe by the scientist Schreiber who carefully fixed the boundaries of the insensible regions of the tongue for many substances among which were sugar and citric acid. The accompanying drawing shows that the unresponsive area corresponding to sugar does not coincide everywhere with the area of insensibility for citric acid, but it shows at the same time the existence of a large territory common to both. Cut a small piece of peeled orange. Express it slightly so as to avoid the dropping and running of the juice over the tongue. Place it in contact with your tongue at nearly one inch from the tip. You will find the orange absolutely tasteless. Bring forward the same piece of orange on to the tip of the tongue and the strong sugar and acid flavor instantaneously reappears.

Streaks of fire drawn from an orange peel.



Some blind spots of the tongue

Dots define region insensible to taste of sugar, dashes, region insensible to citric acid, and shaded region that insensible to orange

It cannot be said that a part only of our gustative organ is insensible to the taste of the essential oil contained in the orange peel, for it is the whole tongue and mouth which do *not* perceive it. To say this while everyone knows the powerful aromatic taste of orange peel seems foolish enough, yet it is true. That particular taste is not a taste but a smell perceived with the nose only, and many other sensations called tastes have not the slightest right to such a title. Yet the statement that such condiments as vanilla or peppermint are tasteless, is sure to arouse considerable opposition if you make it after dinner in a company of laymen. Ask the most determined of your contradictors to leave the room for a moment and meanwhile cut into small pieces some of the outer yellow peel of an orange, which you place into a spoon. Your opponent is then requested to close hermetically his nose and to enter the room. When he is near the table, you ask him moreover to close his eyes and to eat and name the spoonful of food you place into his mouth. As long as his fingers press his nostrils, no amount of chewing or swallowing will enable him to comply with the latter request.

Yet it is not probable that any part of any plant is much richer in essential oil than the yellow epicarp of the orange. It is so loaded with the odoriferous liquid that any change in its shape will produce tiny jets which spring in every direction. To observe these light a candle and bring near it a piece of orange peel held between thumb and forefinger. Double and press the peel, the yellow side facing the candle, as shown in the photograph. Pretty streaks of fire will be seen to start from the candle up to several inches away from it. They are produced by the ignited jets of essential oil.

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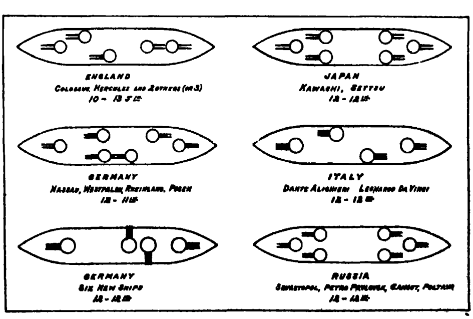
To prevent the drying out of gum Arabic it is only necessary to place a small piece of camphor in the solution. The gum is not thereby impaired but remains adhesive to the last drop. Another method is to add a small addition of glycerine.

SOME NEW WARSHIPS AND THEIR EQUIPMENT.

BY PERCIVAL A. HISLAM.

During the past two months a good deal of information has become available concerning the naval construction of various foreign powers, and this it is proposed to summarize in the following brief paper. The British Admiralty is still very reticent as to the armament of the "Neptune" (laid down in January) and of the four battleships of the current year's programme, but it is generally understood that these five battleships will all be armed with the new 13.5 inch gun with which experiments have been made during the last twelve months. In some quarters it is doubted whether the gun will be in a sufficiently forward state to allow of its being mounted in the 'Neptune,' but its adoption in the four 1909 ships is regarded as certain. None of the ballistics of this gun has been allowed to become public, but its shell will weigh 1,250 pounds, or 400 pounds heavier than the shell of the 12-inch gun which now forms the main armament of most battleships. Ten of these guns will be mounted, their disposition being shown in the accompanying plan.



ENGLAND
Colossus, Hercules and Brothers (or 3)
10 - 13.5″
JAPAN
Kawachi, Settsu
12 - 12″
GERMANY
Nassau, Westfalen, Rheinland, Posen
12 - 11″
ITALY
Dante Alighieri Leonardo Da Vinci
12 - 12″
GERMANY
Six New Ships
12 - 12″
RUSSIA
Sevastopol, Petropavlovsk, Gangut, Poltava
12 - 12″

LATEST "DREADNOUGHT" DESIGNS OF THE NAVAL POWERS.

Much uncertainty still exists as to the armament of most of the German ships of the "Dreadnought" type, of which ten are now under construction. The British Admiralty last year stated that the first four would carry twelve 11-inch and twelve 6.7-inch. This year an official (British) statement places the main armament at the same figure, but gives twelve 6-inch guns as the secondary armament.

This has recently been confirmed by the German government. Much uncertainty, however, still exists as to the armament of the six later German "Dreadnoughts." Fighting Ships, a usually reliable naval annual, states that they will have twelve 12-inch guns divided between four turrets. It should be noted however, that although this plan is stated to have been obtained from an official model, the remark is added that "it is not impossible that one of the middle turrets may be suppressed, and the ships carry only nine 12-inch or even only eight." Sketch plans of the "Rheinland" and "Posen" (sisters to the "Nassau" and "Westfalen") and of the later ships, are given in the accompanying plan.

It is now certain that the armored cruiser "Blucher" will carry twelve 8.2 inch guns (242-pound shell), and the British Admiralty credits her with a secondary armament of eight 5.9 inch. It is impossible to obtain any confirmation of the secondary armament, and those who have seen the vessel say that there is no provision for the mounting of such weapons. Twenty 24-pounders are given as the alternative. She will have a six inch belt and a speed of 23.5 knots with triple-expansion engines of 35,000 horse-power. The "Von der Tann," the first of the real German "Dreadnought" cruisers, which will be completed this year, will carry either eight or ten 11 inch guns. The "G" and "H" of later programmes, will carry ten guns of this caliber disposed as in the "Dreadnought." Their main belt is 7 inches thick, and their speed with Parsons turbines of 45,000 horse-power, 25 knots.

The new scout-cruisers building for the German navy will be of 3,800 tons and will carry fourteen 4.1 inch guns, the speed being 26 knots.

The Japanese battleships "Aki" and "Satsuma," which were laid down in 1905, will not be completed before 1910. They are the first battleships to be built in Japanese yards, and the experience, although doubtless of great value, will have been dearly bought. The "Satsuma" is of 19,350 tons and is armed with four 12 inch, twelve 10-inch, and twelve 4.7 inch guns, while the "Aki," 450 tons larger, will have eight 6-inch instead of the 4.7's. Two new ships have just been laid down, the "Kawachi" at Kure on January 18th and the "Settsu" at Yokosuka on April 1st. On a displacement of 20,800 tons they will carry twelve 12-inch, ten 6-inch and twelve 4.7 inch guns. The "Jiji Shimpo," a Japanese paper, gives only ten 12-inch, but the heavier armament is fully confirmed. Fighting Ships gave these vessels fourteen 12 inch, the end turrets containing three guns apiece, but the design, although produced, was abandoned. The armored cruiser "Kasuga," by the way, has had her single 10-inch gun replaced by two 8-inch, and now is similar in all respects to the "Nisshin." The new 1,150-ton destroyer "Umikaze," built at Maidsuru, has completed her trials successfully, easily maintaining the desired speed of 35 knots. Her engines are of 20,500 horse-power (turbines).

No new vessels have been commenced for the French navy since July of last year. Italy, however, has ordered two battleships of approximately 20,000 tons, their names being "Dante Alighieri" and "Leonardo da Vinci." They will have turbine engines of 30,000 horse-power and a speed of 22 to 23 knots, while their armament will consist of twelve 12-inch guns mounted in four turrets and disposed as shown in the illustration. The secondary battery comprises eighteen 4.7's. Two other battleships are shortly to be ordered, and while their armament may follow that of the earlier vessels it is also rumored that, in accordance with the proposals of Col. Vittorio Cuniberti, the distinguished naval constructor, they may carry eight 14-inch guns of a new type. This burst of activity on the part of Italy is due to the fact that the Austrian government has recently embarked on a four-"Dreadnought" programme, the vessels to carry ten 12-inch guns and to steam 23 knots with engines of 30,000 horse-power.

The reconstruction of the Russian navy has at last

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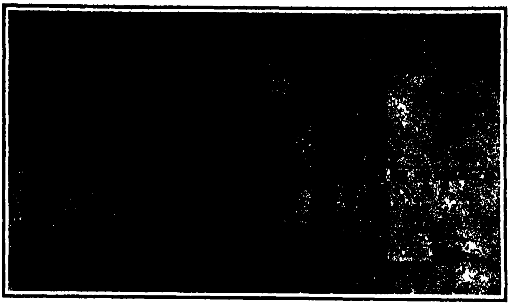
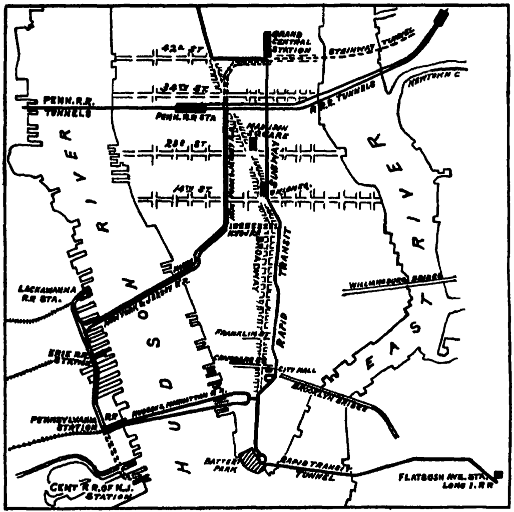
OPENING OF THE DOWN-TOWN HUDSON TUNNELS.

The opening to public traffic of the immense passenger station of the Hudson & Manhattan Railway the terminus of the down town pair of the Hudson Companies' "tubes" under the Hudson Terminal Building, marks a further step in the expansion of this great, inter urban transportation system

When first a sub aqueous connection between New York city and New Jersey was projected by Haskin thirty five years ago his scheme was by many considered visionary but the tributary system of tunnels already completed or immediately projected, not to mention its possible further extensions, all the outgrowth of the original Hudson tunnel would have been beyond his wildest dreams

The first Hudson tunnel was commenced in 1874 and suffered many vicissitudes before its completion passing through the hands of four different operators After being abandoned for eight years excavation was resumed and notable progress made by an English company in 1891 by methods not essentially different from those by which the tunnel was eventually completed and after extending the tunnel to 4,000 feet from the Jersey shaft they abandoned the project only through lack of funds The enterprise of Mr McAdoo supplied the latter and in 1902 the New York & New Jersey Railroad Company took up the work under the direction of Mr C M Jacobs who had done remarkable pioneer work of the same sort in the East River gas tunnel and in March 1905 successfully drove into the New York workings the northern of the pair of tubes into which the original single tunnel had been divided The actual completion of a traversible roadway under the Hudson the long anticipation and many failures of which had made investors skeptical greatly facilitated the financing of an expanded project Alliance was made between the New York and New Jersey Railroad Company and the Hudson & Manhattan Railway which had already projected tunnels from the Pennsylvania station in Jersey City and Cortlandt Street and connecting lines along the Jersey shore and terminal extensions in New York were planned which are best understood by reference to the accompanying map A complete history of the system and description of its methods of excavation fully illustrated was given in our Supplement of February 29th 1908


VIEW OF CONCOURSE, LOOKING NORTH ON WEST SIDE



PLAN OF HUDSON COMPANIES' SYSTEM AND CONNECTIONS

It is the last mentioned pair of tubes from Jersey City to Cortlandt Street that have now been opened to the public, providing as will be seen from the map direct communication from the heart of the financial district to the Pennsylvania, Erie and Lackawanna railroads, while passengers from New Jersey will also be able to step directly into trains of the Interborough subway for uptown Manhattan and the Bronx or Brooklyn

When the extension now authorized is completed *via* stations at Sixth Avenue and 39th Street and Fifth Avenue and 42nd Street to a terminal station between Lexington and Park Avenues further connection will be made there with the Interborough subway Grand Central Station and the Steinway tunnels to Long Island in addition to the connection at 33rd Street with the new Pennsylvania Station and its main line service to the West and South and to Long Island

The newly opened twin tunnels diverge slightly as they leave the Jersey shore entering New York under Cortlandt and Fulton Streets between which is situated the Hudson Terminal Building the largest office building in the world accommodating twenty five thousand persons and carrying in its thirty nine elevators between thirty and forty thousand passengers a day

Inclosed in the eight foot thick solid concrete foundation of this building 75 feet deep 180 feet wide and 4[illegible]0 feet long is the three story station just opened Inclined planes stairways and elevators lead from the street level to the concourse a handsome apartment brilliantly lighted with vaulted roof finished in white glazed tiles relieved with terra cotta containing waiting rooms telegraph and telephone rooms the ticket offices of three New Jersey railroads restaurant barber shop and all the conveniences of a large railway station

Special provision has been made for women in the way of rest and recreation rooms with uniformed maids in attendance and it is suggested that shoppers arriving from the Jersey suburbs may do all their shopping without leaving the building Leading retail stores in all lines have taken space in the concourse and an elaborate system is provided for the ordering of goods from uptown by telephone parcels being received at a special department and kept till called for by home going husbands from down town in the evening

The color scheme of the concourse is white and green all the iron and wood work being of the latter color which is restful and refreshing to the eye The only defect is a somewhat excessive display of advertisements which in order to serve its purpose in catch

(*Concluded on page* 59)

TRAIN LEVEL AT HUDSON TERMINAL, LOOKING NORTH ON WEST SIDE

THE THIRD HONORABLE MENTION ESSAY IN THE FOURTH DIMENSION COMPETITION.

BY CHARLES HENRY SMITH (CARE A. RICHMOND, CHICAGO, ILL.)

[It was one of the conditions of the Fourth Dimension Competition that the editor of the SCIENTIFIC AMERICAN reserved the right to publish those essays which were considered worthy of honorable mention. In accordance with that condition the essay which in the opinion of the judges, Prof. S. A. Mitchell and H. P. Manning, was deemed worthy of third place in the honorable mention class is here printed.—ED.]

A colony of bees housed in a hive with glass walls so that their every movement can be observed affords a very instructive lesson in natural history. Such a glass hive may also serve as a helpful illustration in a consideration of the fourth dimension. Let us imagine a hive with its floor and roof of horizontal glass plates brought so close together that there is barely room for the bees to move about between them, and for the purpose of our illustration let us endow the bees with the intelligence of men. To these bees so confined forward and backward, right and left, would be *familiar ideas* and *their world* would be one of two dimensions only. Debarred from upward and downward movement by the closeness of the glass plates, the words up and down would be meaningless to them because there would be no experience upon which to base these ideas. Imperfect as is the illustration it suggests the conception of a world of only two dimensions, length and breadth.

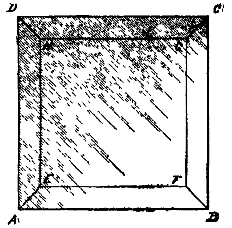
Plane geometry is a science which deals with such figures as triangles, squares and circles. It is interesting to know that it originated in Egypt, where it was developed to facilitate the measurement of land. This origin of the science gave rise to the name geometry, which means earth measurement. Long subsequent to the era of its Egyptian development the science was extended under the name of solid geometry to a study of such figures as spheres, cubes and cones.

The bees in the glass hive could move around a square, could make triangles and circles, and to them plane geometry would be a practical science; but with their ignorance of an up-and-down direction a cube or sphere would be inconceivable, and a third dimension would appear to them as absurd and unthinkable as a fourth dimension does to us. Suppose we lay two pencils on the table so as to cross one another at a right angle and then hold a third pencil so as to form right angles with the other two. While this is obviously a possible thing for us to do, it would be impossible for the bees with their ignorance of the dimension of height. They could of course have two slender pencils in their hive at a right angle to one another, but they could not have a third pencil at right angles to both of the first two. We may look upon the two pencils as representing the two dimensions of the world of the bees and the three pencils as representing the three dimensions of our world. Suppose further that some one tells us to hold a fourth pencil at right angles with the other three. In our field of experience we can find no place for it, just as the bees could find no place in their field of experience for the third pencil. This fourth pencil represents the so-called fourth dimension. Although it is impossible for us to place it, the illustration of the relation of the bees to the third pencil or dimension teaches us that the limitations of experience ought not to be deemed conclusive as to how many dimensions space may have.

It is a matter of pure speculation as to whether there is such a thing as a fourth dimension, whether there are beings of intelligence to whom phenomena are manifested in the form of four dimensions. It is by no means the attitude of mathematicians to instantly recoil from the suggestion, but they are pleased to go ahead and study as accurately as possible under the necessary limitations what may be the properties of a space of four dimensions if there is any such thing. The fundamental guiding principle of their investigation is this: Whatever they find to be the relations of geometry of two dimensions to geometry of three dimensions, they assume that there are similar or analogous relations between geometry of three dimensions and geometry of four dimensions. As the circle is to the sphere, so is the sphere to some unknown body which may have its existence in space of four dimensions. As the square is to the cube, so is the cube to a figure in space of four dimensions which we may call the cuboid.

Of course the fourth dimension is intangible. Mathematicians do not ask us to imagine a fourth dimension, much less do they ask us to believe in it. It is not to be supposed that the most skilled student in this subject has a mental picture of four-dimensional space. Nevertheless the properties and relations of figures existing in four-dimensional space may be investigated and stated.

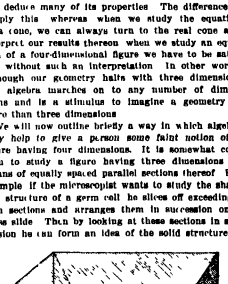
Algebra is the science of numbers. It is a very efficient aid in the study of geometry. Algebra deals largely with equations such as $xy = 12$, which means that x and y are two variable numbers that multiplied together give 12, as for example 3 and 4 or 5 and 2 2/5. All the simpler figures of geometry, such as the straight line and the circle, may be represented by equations; in other words, the equations are condensed descriptions of the respective geometrical figures, somewhat as a score-card is a condensed description of a base-ball game. Mathematicians have learned that the properties of geometrical figures can be studied far more readily by means of their equations than by means of the figures themselves. A mathematician who understands this mode of study can look at the equation of a curve and tell all sorts of interesting and useful properties of it without ever seeing the curve itself—indeed, without even having any mental picture of what the form of the curve may be.



Top view of a glass cube as seen with one eye: a three-dimensional figure appearing in one plane.

Without going into detail, it may be stated that one equation with two variable numbers represents a plane figure; thus $x^2 + y^2 = 15$ represents a circle. One equation with three variable numbers represents a figure in space; thus $x^2 + y^2 - z^2 = 0$ represents a cone. What does one equation with four variable numbers represent, say, for example, $x^2 + y^2 + z^2 + w^2 = 20$? By analogy we should say a figure in space of four dimensions. Although we cannot imagine such a thing, we can pursue our analogies and study this unreal figure by means of its equation, and thus we can deduce many of its properties. The difference is simply this: whereas when we study the equation of a cone, we can always turn to the real cone and interpret our results thereon, when we study an equation of a four-dimensional figure we have to be satisfied without such an interpretation. In other words, although our geometry halts with three dimensions, our algebra marches on to any number of dimensions, and is a stimulus to imagine a geometry of more than three dimensions.

We will now outline briefly a way in which algebra *may help to give a person some faint notion of a* figure having four dimensions. It is somewhat common to study a figure having three dimensions by means of equally spaced parallel sections thereof. For example, if the microscopist wants to study the shape and structure of a germ cell, he slices off exceedingly thin sections and arranges them in succession on a glass slide. Then by looking at these sections in succession he can form an idea of the solid structure of the germ cell. Mathematicians have rules by which such sections of a solid figure may be constructed by means of equations. They start with an equation which represents a solid body, for example, $x^2 + y^2 + z^2 = 9$ representing a sphere, and they perform certain operations by which they get a series of resulting equations that represent the successive sections of the solid body. It remains, then, merely to draw pictures of the sections from the data afforded by the resulting equations. By looking at all these pictures, a person may get a fair idea of the shape of the original solid. In the case of a sphere the sections are circles of varying sizes. As we have already stated, an equation having four variable numbers, should by analogy represent a figure in space of four dimensions. Suppose we have such an equation, as $x^2 + y^2 + z^2 + w^2 = 20$. We can apply the same rules and perform the same operations to get sections of the figure represented by this equation. Curiously but consistently, these sections come out as solid figures. From the data afforded by the resulting equations, the mathematician can model these solid figures in clay and lay them in a row on the table before him. Just as the microscopist looks at the series of sections on his slide to get an idea of the solid structure of the germ cell, so the mathematician can look at the series of clay models before him and possibly feel that he has some idea of the nature of the four-dimensional figure represented by the equation with which he started.



Analogous view of a "cuboid" of four dimensions appearing as a figure of three dimensions.

Thus we see how the fourth dimension may be studied by means of the equations which algebra furnishes. There is another bolder way. We have seen that we can hold three pencils so that each one of them will make a right angle with each of the others. Instead of saying that it is absurd to suppose that a fourth pencil can be held in a position so as to form right angles with each of the first three pencils, let us *assume* that it *can* be done. Without any further assumptions a complete geometry of four dimensions can be built up by pure reasoning. *Many of* its conclusions are no more obvious to the senses than is the fundamental assumption with which it starts. Still that is the *only* assumption, all else may be deduced from that one assumption and from the principles of our well known plane and solid geometry.

An illustration of a special method in the study of space of four dimensions may serve to show how mathematicians reason about such things without being able actually to imagine them. We proceed by ascertaining the relations between two dimensions and three dimensions, and then establishing these relations by analogy between three dimensions and four dimensions. Suppose we have a glass cube resting on the table before us and we close one eye and look straight down upon it with the open eye. Its appearance will be as shown in the accompanying drawing. This drawing is really a plane figure, of two dimensions, and it might have been produced in the following manner, namely, by drawing one square inside of another and then drawing lines connecting the corresponding corners. All this could be done without any thought of three dimensions. The bees in the glass hive could draw such a figure as the one here on the paper before us. Nevertheless, on this figure many of the properties of the cube can be studied. By counting the four-sided figures (*ABCD, EFGH, ABFE, BFGC, CGHD, DHEA*) which we find to be six, we learn how many faces the cube has. By counting the corner points, which are eight, we learn how many corners the cube has. By counting the lines, which are twelve, we learn how many edges the cube has. Just as starting with the squares we are able to get a two dimensional figure which, for the purposes of investigation, may be taken as representing the cube, may it not be possible that starting with cubes we can get a three-dimensional figure which shall represent the four-dimensional figure which we call the cuboid? Just as we drew a smaller square inside of a larger one, so we should think of a smaller cube inside of a larger cube, and just as we drew lines joining the corresponding corners in the case of the squares, so we should make planes joining corresponding edges in the case of the cubes. The figure so formed is somewhat imperfectly pictured in the accompanying drawing, and for the sake of clearness, let us suppose we have such a solid glass figure before us. In the case of the squares to find from them how many square faces the cube has, we counted the big outer square, the small inner square and the four surrounding figures and got six as the result. So in the case of the cubes, to find from them how many cube faces the cuboid has, we count the big outer cube, the small inner cube and the six surrounding solid bodies and thus get eight as the result; this indicates that the cuboid has eight cube faces. A further study of this representative figure discovers that the cuboid has 24 plane square faces, 32 edges and 16 corner points. This shows how we can get a representation of a four-dimensional body and on this representation we can study its properties. There are many considerations which we have not space to present which confirm the accuracy of the deductions that have just been stated.

What is the use of such generalities, abstractions and speculations? About the same as to know whether the earth goes around the sun or the sun goes around the earth. Space is as properly an object of scientific study as are planets or geological strata. Moreover, the study of these fundamental things in geometry throws light on the nature of our own mental equipment. We learn better what is the nature of reasoning processes and how knowledge is built up from simpler and more fundamental elements. Such speculations sometimes lead to very useful results.

If you hold 5 marbles in your hand and are told to take away 8 of them, this suggestion seems as unthinkable as the suggestion of a fourth dimension. But when men chose to represent by —3 the result of subtracting 8 from 5, instead of simply saying it was impossible, then the foundation was laid for the enormously useful science of Algebra.

The assumption of a fourth dimension has not as yet led to any noteworthy useful results, but it is by no means impossible that the science of four-dimensional geometry may come to have useful applications It has been suggested by Prof Karl Pearson that an atom may be a place where ether is flowing into our space from a space of four dimensions. It can be shown mathematically that this would explain many of the phenomena of matter At the present stage the suggestion is regarded, even by its author, as merely fanciful, though it is not as fanciful as the proposition of the German spiritualists who regard the fourth dimension as the abode of their disembodied spirits.

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SOME NEW WARSHIPS AND THEIR EQUIPMENT

(Concluded from page 56)

been entered upon seriously, and four battleships were laid down simultaneously in Baltic yards on June 16th The "Sevastopol" and "Petropavlovsk" are building at the Baltic works and the "Poltava" and "Gangut" at the new Admiralty yard, the English firm of John Brown & Co being in charge of the work On a displacement of 23 000 tons they will carry twelve 12-inch guns, arranged as shown, as well as sixteen 4 7's and four torpedo tubes The speed will be 24 knots and the horse-power 42,000, which is very high for battleships. Meanwhile four other battleships which were laid down in 1903—the "Imperator Pavel" and the "Andrei Pervozvanni" in the Baltic and the "Ioann Zlatoust" and "Evstafi" in the Black Sea—are still incomplete

It is only four years since the first all-big-gun ship was laid down, but the following table will show how completely the idea has seized upon the naval powers It shows the number of battleships of this type completed, under construction, or to be laid down this year

TABLE SHOWING TOTAL GUN POWER OF "DREADNOUGHTS"

	Great Britain.	Germany	United States.	Austria.	Italy	Russia.	Brazil.	Spain.	China.	Japan.	Chili.	Argentine.
Eight 14-in.					8 or 0							
Ten 13.5-in.	4 or 5											
Twelve 12-in	0	6 ?	2		2 or 4	4	3	0		2		
Twelve 11-in		7 or 6										
Ten 12-in.	8 or 7		4	4							2 ?	2
Ten 11-in		0 or 1										
Eight 12-in.	4		2					8	3 ?			
Total in ships of this type	158	156 or 154	60	40	48 or 47	48	36	24	24	24	20	20

We also present a table which analyzes these vessels according to their main armament. It will be seen that, but for her four ships of this year's programme, British designs would "put up a poor show"

	Battleships.	Cruisers.
Great Britain	12*	4
Germany	10	3
United States	8	0
Austria	4	0
Italy	4	0
Russia	4	0
Brazil	3	0
Spain	3†	0
China	3‡ (projected)	0
Japan	2	0
Chili	2 (projected)	0
Argentine	2	0
	57	7

* Besides four "provisional" ships. † Eight 12-inch. ‡ 15,000 tons. Query "Dreadnought" type.

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OPENING OF THE DOWN-TOWN HUDSON TUNNELS

(Concluded from page 57)

ing the eye, must afford a contrast generally garish and out of harmony with the otherwise excellent and subdued decoration.

This is doubtless a considerable source of income, difficult to forego in these commercial days, but considering the dignity and lack of ostentation with which the Hudson Companies have carried out both delicate negotiations and difficult engineering feats, considering also the immense profits likely to accrue from their undertakings, one might have hoped that they would omit this rather cheapening feature.

Stairways lead down from the concourse to the five platforms below, at each of which in rotation, separated by only 1½ minutes during "rush" hours, trains arrive by the southern and depart by the northern tube, there being no switching, and everything tending to the most rapid handling of traffic. Each train discharges its passengers upon the platform on one side of it and receives its new load from the platform at the other side an arrangement which entirely separates incoming from outgoing passengers

Again, below the rail level are extensive baggage and store rooms and a subsidiary power station making the Hudson Terminal Building a veritable city in itself, with clubs at the top multitudinous business offices in between, a post office telegraph office and numerous shops below, and a railway station and power station in the basement, all inclosed within four walls.

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THE SCIENTIFIC WORK OF THE LATE PROF SIMON NEWCOMB

Prof Simon Newcomb died on July 11th in Washington at the age of 74 His death has removed not only the most distinguished astronomer that America ever produced, but a man who is honored the world over for his monumental scientific achievements.

All Newcomb's work followed up with rare perseverance has constantly tended to this ideal end First, to arrive at a more exact knowledge of the magnitudes serving as points of reference and then to establish the theory not only of all the planets but also of their satellites on a system of constants as precise as modern observations permit

Shortly after he graduated from the Lawrence Scientific School at Cambridge, he began the first important problem with which his name is associated, *namely, the motions and orbits of the asteroids* which revolve about the sun between Mars and Jupiter It was once thought that perhaps these numerous bodies might be fragments of a large planet which had been shattered by explosion or collision. Were this true, the orbits would pass through the point at which the explosion occurred As more and more asteroids were discovered the coincidences of orbits became less marked Still the theory was adhered to because it was thought possible that the attraction of the larger planets might have caused perturbations. In order to decide for or against the theory, it was necessary to discover general formulæ by which the positions of the orbits could be determined at any time in the past, so that it could be ascertained whether or not the orbits ever did pass through a common point of explosion, in which case it would be possible to give an approximate date for the catastrophe As a result of Newcomb's painstaking investigation he concluded that the orbits had never passed through any point of common intersection Later investigations based on Newcomb's work have shown that the hypothetical cataclysm never occurred and that the asteroids probably always existed as minor planets. The paper which Newcomb read on the subject at the Springfield meeting of the American Association for the Advancement of Science in 1859 was the first that brought him into prominence—a young man of but twenty four

When Newcomb commenced his work at the Naval Observatory in 1861, the problems of the moon's motion had attracted astronomical attention The most perfect lunar tables at the time were those of Hansen Hansen had only a single assistant and could not therefore make the great number of observations required in the case of a body moving so rapidly as the moon For a year or two Newcomb's observations showed that the moon seemed to be falling a little behind her predicted motion This soon ceased however, and she gradually forged ahead in a most remarkable way In five or six years it was apparent that this acceleration was becoming permanent. Astronomers were puzzled to account for the phenomenon For half a century the moon had apparently been running ahead and had then relaxed her speed so far as to fall behind again Hansen had suggested that the planet Venus might be responsible for these inequalities He showed that for 130 years the moon would thus be made to run ahead and for 130 years to fall behind For 100 years the moon seemed to have followed Hansen's theory Yet Newcomb found that the moon was deviating To ascertain whether or not Hansen's tables represented the motion of the moon perfectly since 1750, as astronomers supposed, Newcomb undertook an examination of the occultations of the moon with bright stars It was not until the telescope had been introduced and used for finding the altitude of a heavenly body and not until the pendulum had been invented by Huyghens that the time of an occultation could be fixed with the required exactness—a task first systematically performed by French astronomers of the eighteenth century Newcomb suspected that some accurate observations had been made before their time, which he might use in checking up Hansen's tables He found that a few such observations had actually been made between 1660 and 1700 and discovered to his surprise that Hansen's tables were evidently much in error But to determine the cause of the errors was impossible without more observations. Newcomb planned a thorough search of the old records of Europe On the occasion of the solar eclipse of 1870 he was sent abroad to observe the phenomenon for the Naval Observatory He seized the opportunity to go to Paris and consult the old records of the observatory there After a search he found that the very observations he wanted had been made in great number by the Paris astronomers both at the observatory and at other points in the city Three or four years were spent in making calculations on the basis of these Parisian researches when it was found that seventy-five years were added in a single step to the period during which the history of the moon's motions could be written Before Newcomb's work this history was supposed to commence with the observations of Bradley at Greenwich about 1750 Now it was extended back to 1665 and with a less degree of accuracy farther still Hansen's tables were found to deviate from the truth in 1675 and subsequent years to a surprising extent But the cause of the deviation is not entirely unfolded even now

In 1877 Newcomb took charge of the Naval Almanac Office He thoroughly reorganized the office and placed it upon a more scientific footing He mapped out a programme of work which involved a discussion of all the observations of value on the positions of the sun, moon and planets and incidentally on the bright fixed stars, made at the leading observatories of the world since 1750—a programme which involved a repetition in the space of ten or fifteen years of an important part of the world's work in astronomy for more than a century past It was impossible to carry out this plan in all its completeness so that Newcomb was obliged to confine himself to a correction of the reductions already made and published For all that, the task was one which, in magnitude probably exceeded any ever before attempted by any astronomer The number of meridians observed on the sun Mercury Venus and Mars alone numbered 62 030 Still other branches of the Nautical Almanac Office work involved the computation of formulæ for the perturbation of the various planets by one another

Important among the troublesome problems with which Newcomb had to deal while in charge of the Nautical Almanac was that of *universal time* There was a day when every railroad had its own meridians by the time of which its trains were run which had to be changed here and there in the case of the great trunk lines and which seldom agreed with the local time of a place The passenger was constantly liable to miss a train, a connection or an engagement by the doubt and confusion thus arising All this was remedied in 1883 by the adoption of our present system of standard times of four different meridians the introduction of which was one of the great reforms of our generation with which Newcomb's name is associated When the change was made Newcomb was in favor of using Washington time as a standard instead of Greenwich But those who were pressing the measure thought it advisable to have a system for the whole world, and for this purpose the meridian of Greenwich was the natural one

By 1894 Newcomb had succeeded in bringing so much of his work as pertained to the reduction of the observations and determination of the elements of the planets to a conclusion So far as the general planets were concerned, it remained only to construct the necessary tables which however, involved several years work Before Newcomb's time the confusion which pervaded the whole system of exact astronomy arising from the disclosures of the fundamental data employed by the astronomers of the various countries and various institutions in their work was such that it was rather exceptional to base any astronomical result on entirely homogeneous and consistent data. To remedy this state of things and to start the exact astronomy of the twentieth century on one basis for the whole world was one of the plans which Newcomb had mapped out for himself when he took charge of the Nautical Almanac Office Dr N W Downing superintendent of the British Nautical Almanac was animated by the same motive He had especially in view the avoidance of duplicate work which arose from the same computations being made in different countries for the same result The field of astronomy is so vast and the quantity of work required to be done so far beyond the power of any one nation that a combination to avoid all such waste was extremely desirable When Newcomb published his preliminary results in 1895 Downing took the initiative in putting the idea into effect by proposing an international conference of the directors of the four leading ephemerides to agree upon a uniform system of data for all computations pertaining to the fixed stars This conference was held in Paris in May 1896

In 1902 when the Carnegie Institution was organized it made a grant to supply Newcomb with computing assistants and other facilities necessary for the completion of his study of the moon's motions

THE DISINFECTION OF SCHOOL BOOKS.

BY JACQUES BOYER.

Although our age prides itself on obeying all the laws of hygiene, many of the administrative regulations which are actually in force directly violate these laws. In the primary schools of France the books pass annually from one pupil to another without any attempt being made to prevent the propagation of contagious diseases in this way. Now, despite the good wishes and efforts of the teachers, the personal cleanliness of the pupil is not always above suspicion. The children often come to school with soiled garments, dirty faces and greasy hands. Even if the morning ablutions have not been entirely neglected, the little ones may carry with them the germs of tuberculosis, scarlet fever, whooping cough, smallpox, or other diseases. The teachers' injunction not to wet the fingers in turning the leaves of books is universally disregarded.

At Montreuil, near Paris, a method of disinfecting school books which should almost entirely prevent the dissemination of disease has recently been introduced, but before we describe this system let us cite a few typical instances of the propagation of diseases by books and papers.

The following case was reported to the Academy of Medicine by Dr. Josias. A lady residing with her daughter in a Breton village which was entirely free from scarlet fever received a letter from the child's governess, who was then traveling in Germany. The governess wrote that she had had an attack of scarlet fever, but was now convalescent and had just entered the period of desquamation. A few days later the mother and daughter contracted scarlet fever. The mother died and the daughter barely escaped with her life.

Brouardel records the propagation of an epidemic of tuberculosis among the clerks of the archives of Kharkof (Russia). One of the clerks, who was in the second stage of tuberculosis, was in the habit of wetting his finger in his mouth in turning over the pages of the registers which he had to consult. French army surgeons have found disease germs in the records of numerous hospitals, and Dr. Knop of New York, in his work on the "Tuberculous Infection of Books," cites the case of twenty clerks of the health department of Lansing, Mich., who became victims of tuberculosis as a result of handling books infected by one of their colleagues. It has been shown by numerous experiments that cultures of microbes spread on paper show a resistance which varies greatly with the species of microbes. The cholera vibrio becomes inert in 48 hours, the germ of diphtheria in 28 days, the bacillus of Eberth in 40 days, and Koch's bacillus in 180 days.

Various methods of disinfecting books have been invented. The most effective method would be the total destruction of the books, but this is too radical to be employed except in rare emergencies. In some English and Scotch cities the public libraries receive daily, from the health bureaus, the names and addresses of all cases of infectious disease. If it is found that any books have circulated in infected houses, these books are disinfected or in some cases destroyed. This system is used in Bradford and Birkenhead. In London, where the density of population would greatly complicate the problem, no books are loaned.

In France, Dr. Lop proposed, several years ago, to disinfect the books of the primary schools every summer, also to disinfect the books, notebooks and clothes of every pupil attacked by a contagious disease. But how can a book be disinfected without damaging it? Kraus recommends exposure to high pressure steam for 40 minutes. The condition of the binding and the pages after such treatment may be left to the reader's imagination. The original process of Berlioz and Championnière does not seem much better. This process consists in subjecting the objects to the vapor of formic and ethylic aldehydes in an oven heated to about 200 deg. F. This treatment, continued for two hours, completely destroys the most virulent germs (tuberculosis, diphtheria, coli bacillus, etc.) placed on the edges or even in the center of the volumes. For example, a large volume of 1,300 pages was selected for experiment. One of the middle pages was saturated with pus, and another was soiled with fecal matter. A portion of each of these pages was torn off for use as a control. The volume was then placed in the disinfecting oven, and heated for two hours and fifteen minutes to about 180 deg. F. Experiments in producing cultures with the soiled parts gave entirely negative results. Unfortunately, the treatment slightly injured both paper and binding. Marsoulan has recently improved this method by the invention of the simple apparatus which is now in use at Montreuil, in the workshops where diseased persons and cripples are employed. In the improved process the books first go through the beater. This machine is a long box connected at one end to an ordinary stove, and provided at the other end with a door through which open racks containing the books are introduced. Inside the box wooden rods are caused to rise and fall, alternately, by cams placed on a cylinder which is turned by a crank. A ventilating fan and a sliding drawer complete this apparatus, which is mounted on trestles. When the crank is turned, the rods strike the covers of the books and dislodge the dust. The heavy dust falls into the drawer upon a mass of saw dust, saturated with a powerful disinfectant, while the lighter dust, carried off by the air current, is consumed in the stove. After this treatment the books are suspended singly by pincers from a series of open metal racks, the covers of the book being bent back. Thus the pages are freely separated, and give easy access to the antiseptic vapor. These racks are mounted on rails, on which they are run into the disinfecting oven. Each of the three ovens employed at Montreuil accommodates two racks of books. The ovens are sheet iron boxes, hermetically closed. Two sides of the box can be raised by cranks to admit the book racks. In the center of the oven is a vessel filled with a solution of formic aldehyde, into which

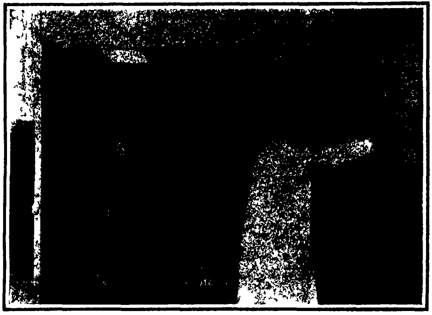

Fig. 4.—Agitating the felt saturated with formic aldehyde.

Fig. 1.—Sliding the rack of books into the disinfecting oven.

Fig. 2.—The disinfecting ovens.

Fig. 3.—The beating machine, which frees the books from dust.

THE DISINFECTION OF SCHOOL BOOKS.

dips a strip of felt, which can be moved up and down from the outside of the oven. The ovens are heated, by steam pipes placed below them, to 122 deg. F The irritating vapor of formic aldehyde makes its escape through a pipe at the top of each oven The operation of disinfection is simple The vessel is filled with formic aldehyde, and the racks laden with books are pushed into the ovens, which are then closed and heated to the required temperature for a few hours After the heating is stopped, the volumes are allowed to remain in the ovens until the next day, when they are found to be entirely aseptic. This improved process of disinfection does not injure either paper or cardboard It is very efficacious as has been proved by the experiments of Dr Miquel, and it is also very cheap, costing only about one-half cent per volume The Municipal Council will shortly be asked to establish new disinfecting plants at various points around Paris, in order to extend the system to all the school libraries of the Department of the Seine Several foreign cities are about to follow this example

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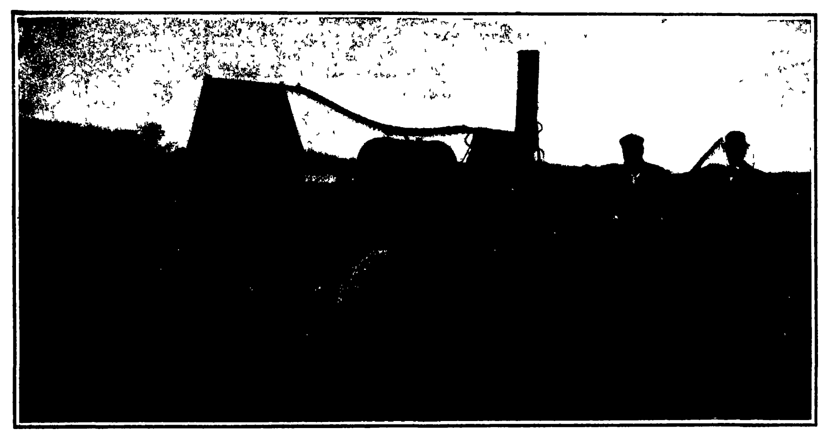
AN AMERICAN FARMOBILE

BY FRANK C. PERKINS.

The accompanying illustration shows an American gasoline plow tractor in service The machine is operated with a cable but the plow is not drawn along wholly by traction Two cable drums are provided, each having five grooves to fit the cable The cable is coiled around the drums five times and then projects from the side of the machine. The harder the pull on the machine the tighter the grip of the cable on the drums. Still, there is no friction because the cable fits the groove, and because the traction wheels and the cable are geared together, so that all the tractive effort and the balance of the load fall on the cable



AN AMERICAN FARMOBILE

When a soft spot is encountered or sand interferes the wheels will slip a little, and the cable will take up the load. In other words, the traction wheel is geared about 10 per cent faster than the cable drums, thus causing the traction wheels always to slip a little on the ground on a hard pull In a field demonstration the cable clutch was thrown out and the machine started, but it could not move from its own tracks. It stood and dug a hole 15 or 18 inches deep The cable was then thrown in by the clutch and the tractor moved on The machine is capable of pulling ten plows at a weight of about 8,500 pounds.

When the tractor is run to the end of the field the cable is uncoupled at the front of the machine and the rear The machine and plows are then turned around, and the front end of the machine is coupled to the cable.

In using the machine it is necessary to stake off a strip of land about 200 to 300 feet wide and to string a cross cable at both ends of the field with a single snatch block running upon it.

It is stated that in some instances as much as a mile of cable is used. By shifting the large bevel gear the pinion is disengaged, so that the machine may be used for threshing or general farm work

The tractor has three speeds, 1½, 2½, and 3½ miles per hour The 2½-mile speed is for traction on the road or the hauling of wagons or machinery across the farm.

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A New Kind of Illuminating Gas.

What is known as the De Laitte system of lighting houses with gas has attracted not a little attention in Europe Private electric light coal or kerosene gas plants, because of their very large initial cost cannot always be installed Since gasoline has come into fairly common use and is obtainable almost everywhere a French inventor M Benoit de Laitte, has devised a method of generating gas from gasoline When gasoline vapor is passed into pipes having a temperature lower than that at which the evaporation is accomplished some of the gasoline will recondense into liquid form Because the supply piping is under ground and exposed to low temperature in winter not a little trouble is thus caused De Laitte has devised a carbureter which is intended completely to vaporize gasoline in very cold weather without the application of heat In it the temperature of evaporation falls as low as —17 deg Fahr which is far below the lowest winter temperature in most civilized countries For this reason condensation is practically impossible

It has been found that air will absorb variable proportions of gasoline depending upon the humidity of the atmosphere To overcome this objection De Laitte extracts all the moisture from the air, which is carefully kept from contact with water and thus the air on carburetion is perfectly dry Hence a uniform gas is produced without the possibility of variation

The principle of the De Laitte process consists in the fact that a measured quantity of gasoline is converted into vapor by a measured quantity of air passed in a brisk current over a large surface of gasoline The particular part of the apparatus in which this is accomplished is the carbureter The current of air is produced by means of a drum which induces a certain fixed quantity of air for each revolution and this movement is obtained by a gear in such a manner that for every cubic foot of air taken up a fixed amount of gasoline is induced into the carbureter By this means a gas of unvarying quality is obtained and perfect evaporation effected

The carburetion takes place in a flat metal tube of considerable width and small depth The gasoline flows downward covering a large surface over which the rapid current of air is conducted The evaporation thus caused is so vigorous, that absolutely no residue is left when good gasoline is employed even at a temperatnre many degrees below the freezing point The proper gas is collected in a small gasometer which serves to regulate the pressure and which acts on the driving power of the drum in such a way that when no gas is required the apparatus is stopped

The motive power necessary to drive the apparatus is exceedingly small—a weight water power, electricity hot air, or a gas motor being employed The gas is burned with incandescent mantles but in consequence of the exceedingly high temperature and combustion, the illuminating power is considerably increased

Between thirty and forty towns are lighted on this plan in Europe In England there are about six thousand installations, which include hundreds of public buildings, railway stations, etc. About twenty or thirty plants are installed in India.

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The Current Supplement.

The current Supplement No 1761 opens with an interesting article by the English correspondent of the Scientific American on a new type of transporter for handling meat at Buenos Aires The length of life of a motor boat and engine is so dependent upon proper care, that it will pay every owner of such a craft to understand thoroughly the vital points to be remembered and to see to it personally that the boat and power plant are kept in good condition Mr Harold Whiting Slauson gives the necessary information in an article entitled The Care and Operation of a Small Motor Boat ' An automatic device for securing the profile of the ground such as is needed for railroad work is described by the Paris correspondent of the Scientific American A graphic comparison of steam and gas engines as power producers is presented James Ferguson s famous mechanical paradox is described—a device which consisted of three geared wheels that performed rather remarkable revolutions because the number of teeth in the three wheels were not the same T C Bridges writes on Martyrs to Science The future of the earth is discussed in an article by Abbé Moreux in which he points out that our earth may be changing its shape S Leonard Bastin writes interestingly on the mimicry of plants G Devaulay contributes a most instructive article on the precision of astronomical observation An apparatus for electrolytic refining of precious metals is described by H La Croix Dr Max Dieckmann presents a partial solution of the problem of electrical vision at a distance We have had occasion recently to mention in these columns a new musical instrument called the choralcelo which depended upon electrically vibrated musical springs for the production of musical sounds The particular apparatus employed is described in the current Supplement

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The wheels of automobiles are usually inclined to the vertical because the spindles on which they turn are slightly inclined to the rest of the axle This practice of inclining the spindle originated in horse-drawn vehicles, in which the wheels are dished that is to say the spokes are arranged not in a plane but in a conical surface with the apex inward for the purpose of giving greater resistance to lateral shocks With the dished wheel the inclination of the spindles is necessary for the wheels of horse-drawn vehicles are high and their spokes long and it is desirable that the spoke which for the moment is supporting the weight should be in a vertical position

It may be doubted whether this argument applies to the small compact, and stout wheels of automobiles The constructors of the first automobiles regretted that the chains apparently made it impossible to incline the driving wheels It was subsequently discovered that the chains did not form an obstacle and hence the wheels are now inclined It is questionable however whether this construction does not have the effect of giving the wheel a tendency to run in a circle and of increasing the friction against the ground

THE FLIGHT OF THE CURTISS AEROPLANE FOR THE SCIENTIFIC AMERICAN TROPHY

After repeating at dusk on July 5th his performance first accomplished on the 26th ultimo of circling two-thirds of the way around Morris Park race track Glenn H Curtiss took the Aeronautic Society's new biplane to Mineola L I, in order to practise with it upon a wide open expanse and if possible set up some records At dusk on July 13th he made three flights—two short ones of 200 to 300 yards and one long one of 1½ miles and nearly 3 minutes duration In the latter the aeroplane disappeared from view and weirdly reappeared from out the fast gathering darkness The following morning an excellent 5 minute flight was accomplished and 24 hours later this performance was almost repeated when a piston cracked in the motor and the flight was necessarily terminated This flight was made in a dense fog between 6 and 7 A M

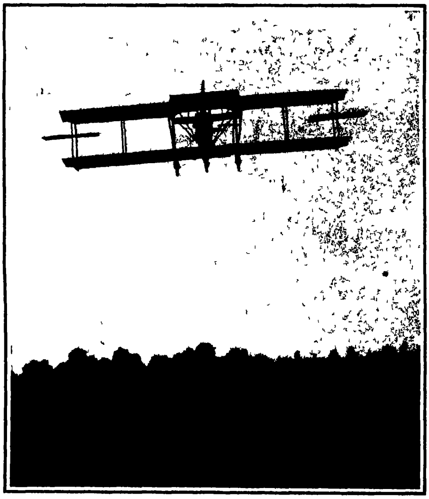
After new and stronger pistons had been fitted Mr Curtiss made two more excellent flights early last Friday morning The first of these started at 5 30 A M and lasted 7 minutes and 20 seconds while the second one which was made at about 7 20 A M lasted 20 minutes and 40 seconds and consisted of some twelve circuits of an oval course of from a mile to a mile and a half in length The height varied from 5 or 6 to 30 or 40 feet There was a light wind of 6 or 8 miles an hour and when the machine flew against it it rose while when it turned to go with the wind it dropped considerably During this flight the aviator described two figure eights with great ease

After the above preliminary practice, Mr Curtiss decided that he would attempt to set up a record for the Scientific American Trophy early last Saturday morning Mr Charles M Manly of the Contest Committee of the Aero Club of America was present and timed the flights As the weather was clear and the air calm the aeroplane was brought out of its tent about 5 00 A M shortly after sunrise A triangular course measuring 1 1/3 miles had been staked out on the vast plain near the village Mr Curtiss decided that he would make one circuit of this course in a second attempt to win the President's prize of the Aero Club of America. These four prizes of $250 each were offered by Mr C F Bishop for the first four machines to fly one kilometer Mr Curtiss covered the required distance in his flight at Morris Park on June 26th, but as this flight was made just after sunset he decided to make another about which there could be no question The rules state that all flights for prizes must take place between sunrise and sunset

About 5 15 A M Mr Curtiss climbed upon the aviator's seat of his small biplane and his assistant started the motor by turning the propeller The machine moved forward quickly as soon as it was released and after traversing about 200 feet of the rough marsh land it rose gracefully and flew straight for the first turn This was taken without any difficulty the machine inclining but slightly inward It then traveled eastward beside a row of trees and was brought about in a wide sweep at the apex of the triangle As it approached the spectators on the last leg of the course it seemed to be traveling very slowly yet that this was not so was shown by the time of the circuit which was 2 minutes and 10 seconds corresponding to an average speed of 31 2 miles an hour After alighting Mr Curtiss stated that he had throttled down his motor so as to fly as slowly as possible

The flight for the Scientific American Trophy was started at 5 23 16 A M The minimum required distance 25 kilometers or 15½ miles—made necessary 12 circuits of the triangular course These were completed successfully in about 33½ minutes but the machine continued flying for seven more rounds It finally alighted at 6 15 46 just 52½ minutes after it crossed the starting line Mr Curtiss would have continued longer had it not been for a rather brisk wind which sprang up while he was making the last three or four rounds. This made the machine more difficult to balance when flying across the wind Nevertheless Mr Curtiss seemed to have no great difficulty in managing it and he could doubtless have continued a quarter of an hour longer if he had had sufficient fuel in the tank The average speed of the machine was about 28¼ miles an hour, if figured upon the actual distance between the stakes of the course, but as the machine did not fly very close to the stakes in making the turns, it is probable that this average speed was considerably over 30 miles an hour The actual measured distance flown was 24 7 miles, while in reality the machine probably covered 30 miles in the 52½ minutes it was in flight

The impression received by the several hundred spectators who witnessed the flight was the slow speed at which the machine seemed to travel and the perfect ease with which it moved forward through the air At times it was sent to a height of 40 or 50 feet, and then again it would drop to within 5 or 6 feet of the ground These ascents and descents were always gradual and were generally the result of the aviator's guiding In making a turn however the machine invariably loses speed and drops perceptibly Sometimes also it would dip inward too much and the aviator could be seen leaning outward in order to set the balancing planes and bring the machine to a level keel As it is only about half the weight of the Wright machine the Curtiss aeroplane does not feel the effects of centrifugal force nearly so much in making a turn and consequently it can negotiate a rather sharp curve with but very slight inclination inward to keep it from skidding The control of the machine by means of a single vertical wheel in front of the aviator (which is pulled or pushed for going up and down and turned for steering sideways) is exceedingly simple and should make it easy for any one used to an automobile and a bicycle to learn to operate it with but little instruction



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GLENN H CURTISS FLYING FOR THE SCIENTIFIC AMERICAN TROPHY

In the Aeronautic Society's new biplane Mr Curtiss flew between 25 and 30 miles in 52½ minutes near Mineola, L I, last Saturday

While Mr Curtiss's record of 52 minutes and 30 seconds will no doubt be increased before the end of the year it is by no means to be despised for a beginning The only record that approaches it in this country was that made by Orville Wright at Fort Myer when he remained aloft 1 hour 14 minutes and 24 seconds last September This flight of Mr Curtiss does not entitle him to the trophy immediately If any other aviator succeeds in outdoing Mr Curtiss's performance then the trophy goes to him Who wins the trophy for 1909 can be determined only at the end of the year for according to the rules the trophy will be won by the aviator who makes the best performance during the year If, during the present year, any other aviator surpasses Mr Curtiss's record made last Saturday it is probable that Mr Curtiss will make another attempt to beat the new record Should he put up the best record for 1909 he will have to win the cup for but one more year to become its permanent holder.

It is especially gratifying to the publishers of the Scientific American that the handsome trophy which they gave to encourage aviation in America, has resulted in the production of two such excellent machines as the "June Bug" of the Aerial Experiment Association (which won the trophy last year) and the new Curtiss machine, which is now the property of the Aeronautic Society With this excellent beginning there is scarcely any doubt that the trophy will be the means of stimulating other inventors to devise and perfect their heavier-than-air flying machines, and probably another year will witness an aeroplane race for the trophy similar to the great automobile races held in recent years.

A New Cross-Country Monoplane Record.

M Louis Bleriot, who is by all odds the most experienced aeroplanist in France, has lately made some excellent new records with his two machines Nos. 11 and 12, both of which have been illustrated in our columns. On June 25th, at Issy-les-Molineaux, M Bleriot flew with his No 12 monoplane for 15½ minutes, making 11 complete circuits of the parade ground despite the fact that there was a rather strong wind blowing On the 26th ultimo he flew for 36 minutes and 55 3/5 seconds, and would have made a longer flight had it not been for the engine missing fire because of over-lubrication The motor used in this machine is a 25 H P three-cylinder air-cooled Anzani engine, which has given excellent results.

After the above-mentioned flights M Bleriot took this machine to Douai where he made a number of excellent flights for prizes. The latest and most sensational flight that this daring aviator has thus far accomplished was made on July 14th with his No 11 monoplane Starting from Etampes, he flew 20 miles across country to Toury, where he alighted and made a stop of 11 minutes. Re-ascending he flew 13 miles farther to Chevilly, where the flight terminated The total duration of the two flights was 45 minutes, which means that the 33 miles was covered at an average speed of 40 miles an hour The fact that this machine, with a weight of 700 pounds, travels at a 40 mile clip with but a 25-horse-power motor speaks well for the efficiency of the single monoplane surface. Both of Bleriot's monoplanes have flown in winds of from 12 to 15 miles an hour successfully and the new cross-country record which he has just achieved places this type of machine in the lead as far as practical point-to-point flying is concerned

* * *

Changes in the Patent Office Staff.

The President has appointed C C Billings first assistant commissioner of patents and F A. Tennant as assistant commissioner of patents. The position of first assistant commissioner of patents was created by the last Congress, as was that of examiner of classification, which is to be filled by E. D Sewall Mr Billings was formerly assistant commissioner Mr R. F Whitehead who formerly occupied the position of law clerk, has been made law examiner, Among other promotions are those of J H Lightfoot, J F McNab, and L D Underwood to principal examiners, H Barker R. E. Marine, J H Carnes, E. Collins Jr, and F W Swanton to first assistant examiners, T L. Mead Jr and W C Wayman to second assistant examiners and H. E Smith to third assistant examiner For the first time in the history of the Patent Office reductions in rank were also made. Two principal examiners have been made assistant examiners.

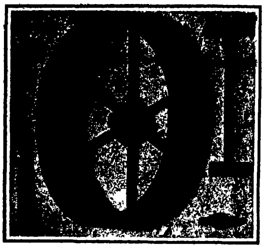
* * *

Defects in insulators may be due, not to improper constituent parts, but to annealing. They may be discovered by means of polarized light. Each insulator is mounted, for purpose of test, so that when rotated about its pin axis the same thickness of glass skirt is between the polarizer and analyzer, which has previously been arranged so as to allow no light to pass. Stresses in the insulator are shown by varying intensity of light and by color changes, being due to improper annealing. Under service conditions the insulators become heated owing to conductive leakage, and are destroyed if the annealing has not been carefully done.

Patent Department

A NEW TYPE OF SPLIT PULLEY

The pulley illustrated in the accompanying engraving has been designed with a view to combining the advantages of the wooden type with those of the steel type of pulley In the improved construction a wooden rim *A* is used with a metal hub *B* and spokes *C* The spokes or arms are attached to the hub and rim without rivets or screw threaded parts They are made of seamless steel tubing pressed into a ribbed form as shown in Figs. 2 and 3 so as to increase their rigidity The hub which is preferably of malleable iron is formed with bosses, each of which is provided with a double-tapered orifice The arms are driven into the orifices in the bosses and by means of a swage their inner ends are flared out so as to fit the orifice and form a flange, as indicated at *D* in Fig 4 The spoke is also formed with a flange *E* which fits against the outer surface of the boss Thus the arm is held against radial movement in the hub The opposite end of each arm is flattened to enter a saddle *F* (Fig 5) which is fitted into the wooden rim of the pulleys. The arm is secured in the saddle by means of a pair of transverse pins, which pass therethrough and enter the wooden rim It is to be understood that the hub and spokes are first completed, and then the rim is built up and the saddle is fitted into the rim during its construction The saddles are also made fast to the rim by means of screws This pulley, it will be observed combines the strength of the steel pulley at the hub with the lightness and friction surface or grip of a wooden pulley The construction is very strong, and not liable to break apart in use

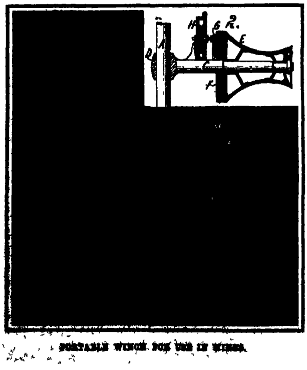


A NEW TYPE OF SPLIT PULLEY

A patent on this improved pulley has been secured by Messrs. R H Noble, T C. Hook, and C S Hook of 79 Victoria Street Toronto, Ontario Canada.

PORTABLE WINCH.

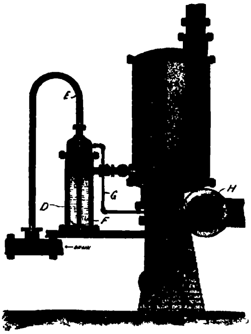
The transfer of heavy material along the low, narrow drifts of a mine may be greatly facilitated by the use of a winch such as illustrated in the accompanying engraving. This winch is arranged to be attached securely upon the walls of the passage but in such a manner that it may readily be removed and set up at any other point as the transfer of material may require A post, *A*, is provided which is adapted to be used in connection with an adjustable extension piece *B*, of suitable length to secure the post in upright position between the floor and roof Extension pieces of different length are furnished to provide for passageways of different height An arm *C*, is fastened by means of a clamp, *D*, to the post *A* at any convenient height thereon A windlass drum *F* is mounted in turn on the arm *C* being held in place by a collar secured to the end of the arm The inner end of the drum is provided with an internal gear, *F* meshing with a pinion *G* The latter is secured to the shaft of a motor *H* which is preferably a turbine propelled by means of air or steam fed through the pipe *J* Any suitable means may be used for controlling the motor so as to start stop or reverse the winch *E* Owing to its simplicity and portability many useful applications for the winch should be found in a mine Mr Charles Wick, of Bingham Canyon Utah, has just secured a patent on this improved winch



PORTABLE WINCH FOR USE IN MINES.

AUTOMATIC DRAIN FOR COMPRESSORS.

In certain types of gas compressors it is common practice to inject water either into the compressor or into the discharge pipe therefrom so as to remove the heat of compression The accompanying engraving illustrates an apparatus designed to separate the water from the gas automatically after it has absorbed its quota of heat and withdraw the water from the separating chamber while maintaining a constant water level in the latter, at the same time preventing the loss of any gas withdrawn from the separating chamber in solution in the water As shown in the illustration the gas and water, under high pressure enter by way of pipe *A* the separating chamber *B* The gas passes through pipe *C* to the storage chamber while the water collects in the bottom of the separating chamber *B* A pipe connects the chamber *B* with a float chamber *D* from which a siphon tube *E* leads to the drain The siphon tube reaches nearly to the bottom of the float chamber *D* and its lower end is adapted to be opened or closed by means of a float *F* in this chamber The float *F* is in the form of a cylinder open at the upper end, while within the float at the bottom is a gasket, which is adapted to be pressed against the end of the siphon tube when the float is buoyed up by the water in the float chamber *D* As the water accumulates in the float chamber *D* it overflows into the float *F* and gradually weighs it down until the end of the siphon tube is uncovered Thereupon the water in the tube is siphoned off until the water level in the float is lowered to such an extent that it will rise again and close the tube The end of the siphon tube *E* is so far below the level of the water, that there is no possibility of the gas flowing off therethrough and the water level in the float chamber *D* remains at approximately the level of the upper edge of the float hence it always covers the inlet pipe connecting the chambers *B* and *D* This prevents gas from escaping directly from chamber *B* into chamber *D* but even should any gas escape into chamber *D* it would be carried off through the pipe *G* to the suction pipe *H* leading to the compressor Mr William D Mount of Saltville Va. has secured a patent on this drain for compressors

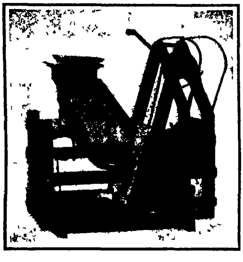


AUTOMATIC DRAIN

PANNING WITHOUT WATER.

BY ROLAND ASHFORD PHILLIPS

No longer need the patient prospector have water in order to pan his gold bearing sand and gravel, no longer must he turn his back upon the great stretches of desert because water is not available For now comes the "dry" machine using air which is always available and which it is claimed will save every bit of "color" that water would save and do the work more expeditiously

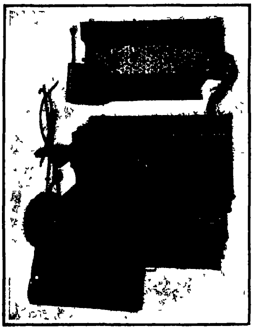


SIDE VIEW OF DRY-GOLD-WASHING MACHINE SET UP READY FOR USE

The one crank operates both machine and blower The sand and gravel are fed in at the hopper on top and allowed to run down the sluice quite in the same manner as in hydraulic sluicing Here however the sluice itself operated by a simple eccentric is given a side shake motion to further separate the particles and to increase the travel of dirt through it

As may be seen in the illustration the bottom of this sluiceway contains a series of riffles These in themselves are unique and prove to be the vital part of the invention Instead of projecting above the surface of the sluiceway as in most sluice boxes they consist of a series of depressions Each depressed riffle or pocket is straight across at the upper edge sloping at the sides curved at the lower edge and having the bottom of the pocket so formed sloping in the opposite direction to the inclination of the sluice The metal forming the bottom of each pocket is continuous at its lower edge with that of the sluice but terminates at the upper end of the pocket at a point vertically below the upper edge of the pocket The opening thus formed in each pocket is covered with a fine wire screen

Under the sluiceway is a chamber air tight except for the screen covered openings of the pockets into which the air is led from the blowing engine This air escaping through the upper opening in each pocket effects an agitation of the gold bearing material forcing all the lighter stuff gradually to the top and this, of course is allowed to run down the



TOP VIEW OF MACHINE, TAKEN APART AND PACKED IN TWO TRUNKS.

incline and is dumped A clean up simply means an unlocking of the riffles and the brushing out of the heavy deposit that remains in the multitude of pockets

The pan shown in the illustration and furnished with each machine holds approximately one twentieth of a cubic yard of gravel Or in other words seven times as much as the ordinary pan This amount of material can be run through the machine in about five minutes. Afterward the riffles are cleaned the deposit saved and a note taken of the location In his spare moments the prospector can compare notes and find out the most valuable location for serious work In this manner a man can travel over a great stretch of ground in a remarkably short time and when completed can decide upon the spot that has given him the most colors

The advantages of this machine are obvious even to those who do not understand mining What appears to be of the most vital importance is the fact that the prospector can go anywhere and at any time without fear of not finding water This means that the countless thousands of acres of desert and arid lands known to be extremely rich in gold bearing sands yet destitute of moisture can now be easily and thoroughly prospected

A great number of these machines are in daily operation especially in the arid regions of Colorado and Nevada and their success is vouched for by the many prospectors who are only too happy to be free to go where they choose and be rid of the drudgery of the crude pan and primitive methods that previously existed Not the least advantage of this prospector's machine lies in the fact that it can be readily taken apart and shipped in two trunks as the illustration shows Packed thus and checked as baggage it will hardly weigh over 200 pounds Unpacked and set up the weight is 180 pounds and one man can carry one without much trouble

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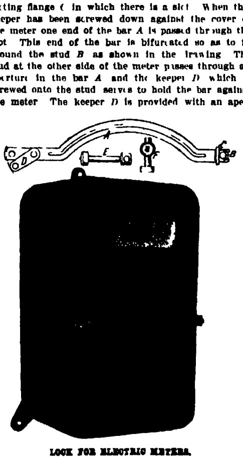
LOCK FOR ELECTRIC METERS

A very simple and inexpensive lock has recently been devised for use on electric meters The lock cannot be opened without breaking a seal and hence it will reveal any tampering with the meter by an unauthorized person The lock is particularly adapted for that type of meter in which the cover is secured by two studs on which a pair of keepers are threaded It comprises a bar *A* which extends across the face of the meter and is made fast to the two keepers in such a way as to keep them from being unscrewed from the studs One of the keepers which is screwed onto the stud *B* is provided with an outwardly projecting flange *C* in which there is a slot When this keeper has been screwed down against the cover of the meter one end of the bar *A* is passed through the slot This end of the bar is bifurcated so as to fit around the stud *B* as shown in the drawing The stud at the other side of the meter passes through an aperture in the bar *A* and the keeper *D* which is screwed onto the stud serves to hold the bar against the meter The keeper *D* is provided with an aperture adapted to be brought into register with an aperture in the bar and when the keeper has been screwed home a seal is passed through the two apertures The seal consists of a leaden stud such as shown at *E* On the projecting shank of the stud a collar of lead is fitted and by means of a punch both collar and shank are flattened and jammed together while an impression is left on the seal as indicated at *F* It will be observed that the locking bar *A* is curved so as not to cover the volt and ampere readings of the meter A patent on this improved lock has been granted to Mr Joseph H Jackson of 343 Atlantic Avenue Brooklyn N Y



LOCK FOR ELECTRIC METERS.

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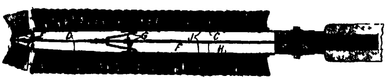
EXPANDING BRUSH FOR CLEANSING BOTTLES

A new form of brush has just been invented which is so arranged that after it has been introduced into the bottle it may be expanded to conform to the shape of the bottle and thus render the cleansing of the interior more thorough. While the device is particularly adapted for cleansing milk bottles it may also be employed advantageously for other purposes in which it is necessary to introduce a brush through a small mouth or neck In our illustration the head *D* of the brush is attached to the spindle *B* of the bottle-washing machine Secured to the head are two flexible strips *C* of spring metal Attached to these flexible pieces are a pair of extension strips *D* which at their opposite ends are connected by a pair of hinged leaves *E* A controlling slide *F* is attached to the leaves *F* at one end while its opposite end enters a slot in the head *A* The controlling slide *F* is connected to the flexible strips *C* by means of links *G* The backs which carry the bristles of the brush are directly secured to the strips *D* and leaves *F* but in the case of the flexible strips *C* clips *H* are provided which are riveted to the strips *C* and are arranged to have sliding engagement with flexible backs *J* on which the bristles are secured The operation of the device is very simple When the brush is introduced into the bottle the controlling slide *F* comes in contact with the bottom of the bottle and is thus forced back into the slot in the head *A* This causes the leaves *F* and links *J* to swing open thereby expanding the brush to conform with the inner contour of the bottle Messrs John T Heywang Jr and Minard Slater of 201 West 73d Street New York city have secured a patent on this expanding brush



EXPANDING BRUSH FOR CLEANSING BOTTLES

◆

APPARATUS FOR PURIFYING WATER BY THE INJECTION OF OZONE

The apparatus shown in the accompanying engraving purifies water by the introduction of ozone through an aspirator Either direct or alternating current (usually at 110 volts) is taken from the ordinary electric light circuit and by a transformer is stepped up to about 8 000 volts This high voltage produces in the ozonizer (a box containing alternate plates of aluminium and micanite) a slight electric discharge generating ozone from the air drawn through the ozonizer

The water to be treated flows under its own pressure from the city mains through the pipe to its highest point and in descending draws the ozone by means of an aspirator from the ozonizer the water and ozone thoroughly commingling This action is continued during the progress of the water in its descent into the glass sterilizer where the ozone ascends in millions of minute bubbles again coming into intimate contact with all parts of the water and destroying the bacteria therein The ozonized water then finds an outlet at the top of the sterilizer and may be conducted into any suitable storage receptacle for future use

The reason for this destruction of the bacteria by the ozone is very simple Chemical analysis of the bodies of bacteria shows that they are made up of about 84 per cent of water and 16 per cent of solids Of these solids more than half is made up of carbon Ozone being a concentrated form of oxygen has a very great affinity for carbon and the moment a bacillus comes in contact with a bubble of ozonized air the carbon of its body combines with oxygen and the bacillus is consumed as completely as if it had touched a flame The product of combustion is carbonic acid which is partly absorbed by the water the excess rising to the surface of the water and passing off into the air

The cost of purifying water by this process is but a small fractional part of a cent per gallon

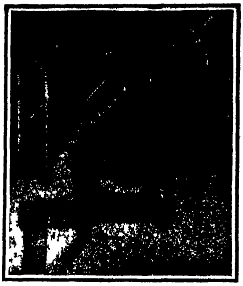
With six feet of overhead space the apparatus is capable of purifying 4 000 gallons of water per day and can be accommodated on a shelf three feet long and one foot wide the area required being only slightly increased for larger installations

PURIFYING WATER BY THE INJECTION OF OZONE THROUGH AN ASPIRATOR.

PAPER HANGER'S TRIMMER.

Pictured in the accompanying engraving is a paper hanger's table of improved design with a device mounted thereon whereby wall paper may be cut and trimmed with clean edges The table is of the folding type and is so arranged that when folded it occupies an unusually small compass The surface of the table is inlaid at one edge adjacent to the cutter with strips of wood of different color, and is provided with a scale extending at right angles to the inlaid strips. This serves as a gage for cutting the paper to the desired dimensions The cutter may be removed from the table top when it is desired to fold the table The sectional view in our engraving shows the details of the cutting device It consists of a cutting wheel or disk *A* which is arranged to be moved laterally by means of a thumb lever *B* against a straight edge so as to insure a clean cut The shaft on which the cutter wheel is mounted carries a roller *E* at the opposite end which is pressed against the table by the operator when moving the cutter over the paper *D* To protect the hand from the rotating parts a cage *C* extends over the shaft and roller *E* and this is grasped by the hand of the operator with the thumb conveniently placed on the lever *B* The carriage on which the cutter is mounted is provided with fingers *F* which engage a guide rail mounted on the table top parallel with the straight edge Were it not for the lever *B* which enables the operator to press the cutting disk *A* against the straight edge any inequalities in the guide rail would separate the wheel slightly from the straight edge causing a ragged cut of the paper

The inventor of this improved paper hanger's trimmer is Mr E F Goble Brattleboro Vt



PAPER HANGER'S TRIMMER.

RECENTLY PATENTED INVENTIONS.

Of General Interest.

WALL CONSTRUCTION.—G. P White, Wallace, Idaho. The invention refers to concrete blocks, and its object is to provide a construction, arranged to form air spaces between the outer and inner courses, and to allow a perfect circulation of air through the spaces both in a horizontal and vertical direction, with a view to prevent the penetration of moisture through the wall to the interior of the building.

CABLE-SQUEEZER.—H D. Robinson, New York, N Y The aim of the inventor is to provide a device which may be easily and quickly applied to the mass of strands making up the cable, which will force them together into a perfectly cylindrical mass, and which may be very readily loosened and moved after the permanent securing means has been applied adjacent the point last squeezed into shape.

Heating and Lighting.

WATER-HEATER.—O C Sylvester, Taunton, Mass. This heater is adapted for domestic purposes, and more especially for use in connection with the boiler of a steam heating system to replace or augment the water front of the range The heating chamber consists of a cylindrical body having expanded heads secured at opposite ends a coil within the chamber and an inlet and outlet to and from the chamber for circulation of the heating fluid. Where the coil return and supply pipes pass into the head the inventor provides outwardly projecting nipples surrounding the pipe, the former having packing nuts, and thus forming in connection with the pipes annular heating spaces in communication with the chamber

Machines and Mechanical Devices.

ATTACHMENT FOR LOOMS.—W P Watson, Middletown, Conn The invention has in view a suitable mechanism in connection with a loom for raising and lowering the weights used to maintain a tension on the warp Two weights are simultaneously raised and lowered by mechanical means preferably operable from the front of the machine, which means permits of a heavier weighting and consequently the lengthening of the warp and an increase in production

TUBULAR TRITURATING MILL.—R R Shaffer, New York, N Y The invention is an improvement in mills of the character which contain a quantity of pebbles, spheres or other pulverizing elements In machines of this nature the material to be ground is introduced into the grinding tube having the pebbles, and as it revolves they roll upon each other and reduce material to powder The inventor's aim is to get rid of the large per cent of dead weight of the pebbles and increase the mill's grinding capacity

FRICTION-CONTROLLING DEVICE.—S. J Dibbins, New York, N Y The device insures the easy working of the friction clutch reduces the friction of the working parts to a minimum, and avoids weakening of the drum shaft. Use is made of a device external of the shaft, and having a spring-pressed pressure device engaging a grooved collar on the movable clutch member and a normally-controlled pressure nut screwing on a pressure screw on the pressure device

OPERATING TABLE.—J Laughlin, Ledyard Iowa. Dr Laughlin in this invention provides a table that may be adjusted in a variety of positions, being capable of rising and falling movement rotary movement tilting on its longitudinal axis, and tilting on its transverse axis, and also an infinite variety of combinations of the two tilting movements

LADDER.—I R Conkoff and R S Lovett Portland, Ore The ladder is for use by firemen it being capable of considerable and rapid extension, adapting it for use in connection with tall buildings. One embodiment of the invention consists of a ladder composed of a series of sections of varying widths telescoped one within the other and a gear mechanism for driving the several sections, causing them to simultaneously move with respect to each other

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper

NEW BOOKS, ETC.

Cane Sugar and its Manufacture. By H C Prinsen Geerligs, Late Director of the West Java Sugar Experiment Station Manchester (Altringham) Norman Rodger, 1909 Levant octavo; pp. 350.

Mr Geerligs has collected in this book pretty much everything that is known about the chemistry and technology of sugar cane and cane-sugar manufacture. In a way the book may be regarded as a supplement to Noel Deerr's work on sugar and the sugar cane for it carefully avoids the discussion of machinery which finds so prominent a place in Deerr's work, and confines itself largely to the chemical side of sugar cane. The chapters are seven in number, and their subjects are respectively "Constituents of the Sugar Cane," "Proportion and Distribution of the Constituents of Sugar Cane," "Extraction of the Juice," "Clarification," "Concentration of the Juice," "Curing" and "Exhausted Molasses."

Électricité Agricole Par A. Petit, ingénieur agronome et ingénieur électricien. 1909, 1 volume in 18 de 400 pages, avec 100 figures. Librairie J.-B. Baillière et fils, 19 rue Hautefeuille, à Paris.

M. Petit first presents some general considerations on the adaptation of electricity to the farm, energy and some general theories in electricity He then considers the production of electric energy by all possible practical means—dynamos, water motors, steam engines gas engines gasoline engines, and windmills He lastly sets forth the comparative merits of these various methods, cost of each installation, and the mechanical and electrical conditions involved Inasmuch as electrical energy is conducted by wires to the machines which it is intended to drive he naturally describes the apparatus employed between generating and receiving stations in a chapter entitled "Transportation and Distribution The energy thus conveyed is utilized in various forms. How it is utilized, a chapter on utilization explains.

The Fireless Cook Book A Manual of the Construction and Use of Appliances for Cooking by Retained Heat With 250 Recipes. By Margaret J Mitchell, Director of Domestic Science in Public Schools Bradford Pa Instructor in Domestic Science Drexel Institute, Philadelphia, Pa New York Doubleday, Page & Co, 1909 Price, $1 25

The fireless cooker is another name for the insulated oven or hay box which has been introduced into this country from Europe By its means food is subjected to a brief preliminary cooking and placed in the hay box where the cooking process is continued for some time after without the aid of fuel It is the purpose of this book to present in a convenient form directions for making and using fireless cookers, so that those who are not experienced even in the ordinary methods of cookery may be able to follow them easily and with success. Naturally a book such as this must be used in the kitchen before any opinion as to its practical value can be delivered It seems to us, however that the book has been well designed to attain the object for which it is written

The Westinghouse E-T Air Brake Instruction Pocket Book By W W Wood New York Norman W Henley Publishing Company, 1909 16mo pp 242 Price $2

This is an admirable example of what a technical book should be The illustrations are mostly in the form of plates and are appropriately colored to distinguish the various pressures. We have rarely seen better examples of fine color printing The register is most accurate, and the coloring will tend to simplify the descriptions for the student The publisher has taken the very wise precaution of copyrighting every individual illustration It is strange that more publishers do not do this, as it would save them from the vast legion of pirates that are always ready to snap up every good book. The author is a practical air brake instructor The examination questions are given in the popular question-and-answer form. It is a beautiful example of book making, and reflects the greatest possible credit upon the publisher

The Real Estate Educator By F M Payne New York T J Carey 1908 18mo, pp 256 Price $2

This is a repository of useful information for ready reference especially designed for real estate agents, operators builders, contractors and business men The advice given seems to be very sensible and the book will probably be of value to those who are engaged in buying or selling real estate

Engineers Manual for Installation and Operation of the Reeves Variable Speed Transmission Columbus, Ind The Reeves Pulley Company, 1909 24mo, pp 59 Price, $1

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READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. **In every case it is necessary to give the number of the inquiry.** Where manufacturers do not respond promptly the inquiry may be repeated.

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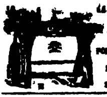

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CHEMICAL AFFINITY. Simply explained by SIR OLIVER LODGE. SCIENTIFIC AMERICAN SUPPLEMENT 1547.

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STEAM TURBINES. Their Construction, Operation and Commercial Application. SCIENTIFIC AMERICAN SUPPLEMENTS 1306, 1307, 1308, 1422, 1400, 1447, 1370, 1372, 1521. The articles have all been prepared by experts in steam engineering.

PORTLAND CEMENT MAKING is described in excellent articles contained in SCIENTIFIC AMERICAN SUPPLEMENTS 1433, 1465, 1466, 1510, 1511.

AERIAL NAVIGATION. Theoretical and Practical Discussions, Pictures and Descriptions of actually-built dirigible balloons and aeroplanes will be found in SCIENTIFIC AMERICAN SUPPLEMENTS 1161, 1149, 1150, 1151, 1404, 1405, 1413, 1433.

THE TANTALUM LAMP. A full illustrated description of a lamp having a metallic filament and burning at once without preliminary heating appears in SCIENTIFIC AMERICAN SUPPLEMENT 1523.

THE WATERPROOFING OF FABRICS is thoroughly discussed in SCIENTIFIC AMERICAN SUPPLEMENT 1522 by an expert.

THE SPARK COIL, ITS CONSTRUCTION AND MAINTENANCE, is the subject of a painstaking article in SCIENTIFIC AMERICAN SUPPLEMENT 1522.

ELECTRIC IGNITERS FOR GAS ENGINES are discussed in SCIENTIFIC AMERICAN SUPPLEMENT 1514.

CARBURETERS, a subject of immense importance to automobilists and the users of oil engines, is well treated in SCIENTIFIC AMERICAN SUPPLEMENT 1508.

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SEALED PROPOSALS will be received at the office of the Director of the Census, Washington, D. C., until 2 o'clock, P. M., August 9, 1909, and then publicly opened for furnishing all the labor, materials and work necessary for the construction in lots of 60, 75, 100, or 125 tabulating machines and delivering the same complete, free of all charges for transportation, at the Census Building, Washington, D. C. The right is reserved to accept or reject any or all bids in whole or part, to strike out any item or items in the specifications, and to waive any defects. For specifications blue print drawings, blank proposals, and full information address E. DANA DURAND Director of the Census, Department of Commerce and Labor Washington, D. C.

CARD PUNCHING MACHINES; POSTPONEMENT OF OPENING OF BIDS.—The time for the opening of bids for furnishing all the labor, materials and work necessary for the construction in lots of 100, 150, 200, 250 or 300 Automatic Card Punching Machines and delivering the same complete, free of charge for transportation, at the Census Building, Washington, D. C. is hereby extended from July 15, 1909, the date previously advertised, to July 28, 1909. Bids will be received at the office of the Director of the Census, Washington D. C. until 2 o'clock, P. M., on that date. For further information, specifications, blue print drawings, blank proposals, and full information address E. DANA DURAND, Director of the Census, Department of Commerce and Labor Washington D. C.

WANTED.—DRAFTSMAN FOR DESIGN OF HEATING SYSTEMS at $6.00 per diem. Bureau of Yards and Docks, Navy Department. An examination will be held at the Navy Yard, Washington, D. C. July 30, 1909, to fill the above position. For application and further information address "COMMANDANT" Navy Yard, Washington, D. C.

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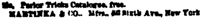

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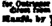

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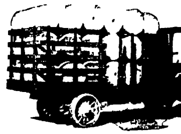

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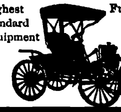

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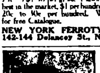

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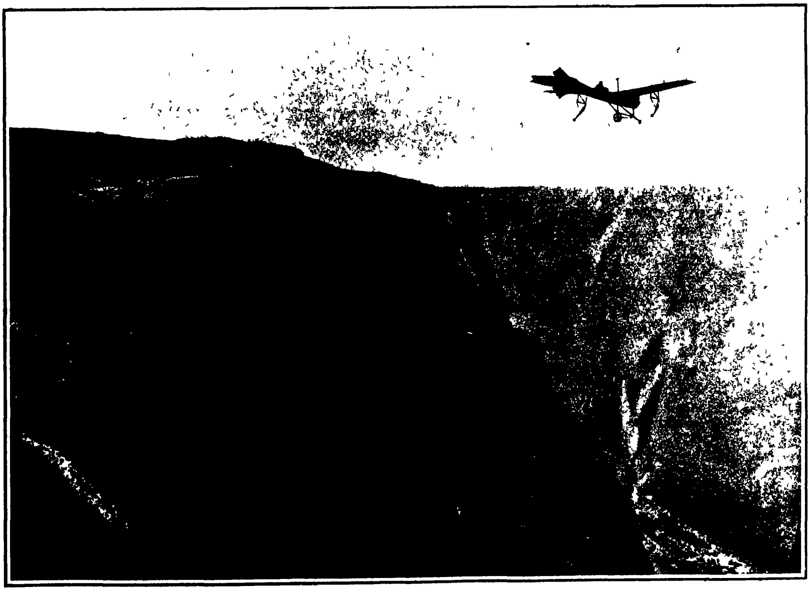

Hubert Latham on his 50 H. P. "Antoinette IV" monoplane starting from the high cliff at Sangatte, France.

THE FIRST ATTEMPT TO FLY ACROSS THE ENGLISH CHANNEL.—[See page 78.]

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NEW YORK SATURDAY JULY 31st 1909

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest If the photographs are *sharp* the articles *short* and the facts *authentic* the contributions will receive special attention Accepted articles will be paid for at regular space rates

GOOD NEWS FROM PANAMA

The latest official report from Panama gives some very reassuring facts regarding the question of seepage of water through the ground in the neighborhood of the Gatun dam It will be remembered that in the controversy over this dam M Bunau Varilla and others claimed that the head of eighty five feet of water in the Gatun dam would probably produce a heavy seepage, if not through the body of the dam itself then through the underlying material of the valley bottom on which the dam was built The engineers of the canal on the other hand assert that not only will the body of the dam itself which is to be deposited hydraulically be so compact as to preclude any possibility of seepage but that the subsoil in the valley is naturally impervious or practically so to water

Partial confirmation of the engineers statements is now afforded by the conditions which have developed during the excavating of that portion of the canal which lies between the Gatun locks and the sea where one of the steam shovels has reached a depth of 32 feet below sea level The excavation in which the shovels are at work is kept dry by four 8 inch pumps, and ordinarily these pumps are not run at their full capacity When it is considered that a dike a few feet in thickness only keeps the water in the old French canal from flowing into the trench that the sea is within two miles of the excavation and furthermore, that the Mindi River flows within a few hundred yards of the ditch we are quite in agreement with the engineers that there has been surprisingly little seepage into the excavation since the work was carried below sea level ' During the latter part of June the shovel on the lowest level was obliged to suspend for a few days on account of the inability of the pumps to throw out the water that was coming in this however, proved to be only a temporary condition and the shovels were soon able to resume work It does not take an engineer to understand the significance of these facts as bearing upon the security of the Gatun dam

NAVAL ANNUALS OF 1909

The public interest in naval affairs which has been noticeably on the increase during the present decade has received a decided stimulus from the introduction of the Dreadnought type of battleship and its dramatic effect as shown in the so-called British panic over the activity of Germany in rebuilding its fleet along Dreadnought lines Hence the appearance of the two best known naval annuals, those of Brassey and Jane affords much timely information on a subject of vital importance The older annual which opens with a quotation from the speech of the First Lord of the Admiralty on the Navy Estimates made last March The safety of the empire stands above all other consideration No matter what the cost, the safety of the country must be assured " is divided into the customary four parts The first contains general articles on naval subjects of prime importance and is enlivened by some excellent half-tone engravings from wash drawings of the more notable of the latest ships built or building for the navies of the world. Part two contains Brassey's familiar list of British and foreign ships which includes the class displacement dimensions horse-power builder of ship and engine dates of launch and completion cost the position and thickness of armor on the ship the gun positions, the armament speed and coal capacity Following this are plates of the typical warships of each navy including outboard profiles and deck plans, with a summary of the principal elements of each ship given below This summary is a new departure in this year's Annual, and adds greatly to the value of the plates. Part three is devoted to articles on armor and ordnance and is followed by sets of tables, giving full details of the dimensions, velocity, energy, and penetration of every gun manufactured by the principal navies and by the leading private manufacturers of ordnance Part four, embodying the First Lord's Memorandum gives a great variety of information as to expenditures, personnel, condition of the ships, arsenals dockyards, etc

There is no more satisfactory way of conveying much information regarding a warship in a limited space than is found in a broadside photograph combined with a plan and side elevation If the latter be freely dimensioned and the group of illustrations be supplemented by a tabular description, the reader is put into possession of a *multum in parvo* of the particular ship described Jane's "Fighting Ships" is modeled on this plan, and since it contains this information regarding every ship of importance in all the navies of the world, big or little, it can be seen the work is remarkably complete Naturally, in view of the little argument between Great Britain and Germany on the subject of battleship construction, readers of the Annual will turn first to the pages dealing with the German navy Germany has been unusually successful in maintaining secrecy about her new 'Dreadnoughts,' so much so that Mr Jane in spite of all his assiduity in searching for the latest naval information has to confess that "it is not possible even now absolutely to guarantee the exact correctness of the set of plans given with this edition" He anticipates regarding them that there will very possibly be considerable discussion"

Turning, then to the plates of the new German Dreadnoughts,' we find that the Westfalen and 'Nassau (1908) are credited with ten 11 inch 50-caliber guns mounted in five turrets disposed similarly to those of the original "Dreadnought," viz., one turret forward one on either beam, and two astern This on a displacement of 17 710 tons is reasonable and probably correct We have always as our readers will doubtless recollect, considered that the crediting of these ships with fourteen and even sixteen 11 inch guns was absurd The "Posen' and "Rheinman" (1908) are credited with carrying twelve 11-inch 50-caliber guns on a displacement of 19 000 tons. Commencing from the bow the first six guns are mounted as in the 'Dreadnought —one turret forward and one on either beam abreast of each other Aft of the superstructure are two two-gun turrets placed *en echelon*, and astern on the center line is another turret This arrangement gives a concentration of six guns ahead and astern and ten on each broadside The plans of the latest six 'Dreadnoughts of the German navy call for criticism On a displacement of 19 000 tons they are supposed to carry twelve 12 inch guns in four turrets mounted on the center line the forward and after turrets each containing three guns We think it is highly improbable that the three-gun turret will ever be found on the German ships or on those of any other navy Jane credits the Japanese with carrying fourteen 12 inch guns on their latest design six of which are carried in two three-gun turrets, one forward and one aft. There is strong objection to the three gun turret on the ground that a single 12-inch high-explosive shell penetrating such a turret would probably put three guns out of action at once. An even more serious objection is that the greater the number of guns carried upon a single turntable, the slower the rate of fire per gun, unless indeed volley firing be adopted and all three guns are loaded and fired together, a practice which would involve enormous strains upon the turntable If the guns are fired separately they must wait upon each other, since the firing of any one gun, or at any rate of either of the outer guns of the three, throws the other two guns off the target and would necessitate a re-sighting The ideal mounting for speed and accuracy would be to mount each 12-inch gun in a single turret. This, however, would involve too much turret weight and would cut down the number of guns that could be carried The armament of the German "Invincible" type of battleship cruisers is given as ten 11 inch 50-caliber guns, mounted as in the "Dreadnought," the displacement of the ship being 19,000 tons and the speed 25 knots The "Bluecher," of 14,760 tons, is armed with twelve 8 2-inch guns

Next to the German navy, perhaps that of Japan will excite the greatest interest. The two new "Dreadnoughts" which are building, and the three or four others projected, according to Jane, will carry fourteen 12-inch guns on a displacement of 20,750 tons. Since it takes 26,000 tons to carry twelve 12-inch guns in our own 'Wyoming," we are at a loss to understand how the Japanese are going to carry two more guns on 5 000 tons less displacement. Either the speed must be less than the 20 knots given, or the armor plan must be considerably cut down. The Annual gives particulars of the five battleships and three cruisers captured from the Russians, or raised after the capitulation of Port Arthur The "Iwami," formerly "Orel," has not only had her superstructures and smokestacks cut down, but has been re-armed with four 12-inch and six 8-inch 45-caliber Japanese guns. The "Hizen," formerly "Retvisan," still carries her armament of four 12 inch 40-caliber and twelve 6-inch 45-caliber Russian guns. The "Suwo," formerly "Pobieda," has been re-armed with four 40-caliber 12-inch and ten 45-caliber 6-inch Japanese guns, and her efficiency is therefore considerably increased. The "Sagami," formerly 'Peresviet," has been re-armed with four 12-inch 45-caliber and ten 6-inch 45-caliber guns. The re-arming of these ships has provided the Japanese navy with four effective battleships of the pre-"Dreadnought" type

Very properly Jane has always laid great stress upon the main battery as being the principal determining factor above all others in a comparison of the fighting strength of the world's navies. On this basis he presents a table entitled "Ships Built or Building in the Principal Navies, Armed with Guns Equal or Superior to the 12-Inch 45-Caliber Gun," which is able to attack 11 inches of Krupp armor outside of 7,000 yards range. In this table the adherence for many years past of the United States to the 12-inch and 13-inch gun shows to good effect. As matters stand to-day, Japan comes first, with eleven such ships, followed by the United States with ten, Great Britain with nine, France with four and Germany with three. In 1910 and 1911 Japan will still hold the first position, with Great Britain and the United States second, France third, and Germany fourth In 1912 Great Britain will be first with twenty-two such ships, Japan second with seventeen, followed by the United States and France with sixteen each Germany with thirteen, Austria with seven, and Italy with two This forecast, however is, of course, liable to great modification due to change of programmes.

AS OTHERS SEE US.

Any communications from our readers, which throw any light upon what the subscribers desire to find in our columns, are most welcome always to the Editor, whether such letters are in the nature of commendation or criticism As a rule, the Editor is not able to determine whether certain features or departments in the paper are really appreciated by the readers, unless the friends of the paper will take the trouble to write the Editor and express their opinion or their preferences.

Occasion has arisen in the past when it was deemed desirable to make some change or eliminate some department of the paper, and the Editor has not been aware that such department may have been of the greatest interest to certain readers until a storm of protest leads to his restoring the omitted feature

The following letters were received by the Editor recently in a single mail, and by their diversity and wide geographical range were of interest to him, and may be so to some of our readers

A correspondent from Eugene, Ore, writes

"I have enjoyed reading the SCIENTIFIC AMERICAN immensely and hope to be able to continue it for years

Have a small shop and some tools and have made several things from directions given in the Handy Man's Workshop Department. Such work is, to me, great pleasure, since there is enough—without being too much or having anything omitted—in the instructions.

"I wish you unmeasured success."

The editor of a paper in Michigan writes

"Allow me to commend you enthusiastically on the fourth-dimension contest. Without taking exception to the work of the committee, I feel very strongly that Mr Cutler's paper in the issue of July 10th is most timely and valuable, as loose thinking on the part of readers, especially if it favors superstitious conclusions, is too common What the fourth dimension is not is more important to persons not mathematicians than what it is."

A large firm of manufacturers in Jerome, Ariz., writes

We are steady subscribers to the SCIENTIFIC AMERICAN and could not get along without it."

A French correspondent in Paris writes

"Being now a faithful subscriber, I must come and say to you that in the first place in this paper I read and use your Queries. This for two reasons First. I do not know any other piece of any other scientific paper which gives me so many truth and new ideas, in all kinds of fashion Really, I take out a great deal from them, and I cannot say how sorry I was when several weeks, some time ago, my dear Queries were absent. Second. My second reason for liking the Queries so much is the pleasure one has in looking at the idleness (*sic*) of some fellows.

"Questions such as, 'Which goes fastest, top or bottom of a wheel?' or 'Why does salt freeze in summer (to cool drinks) and melt in winter (to melt snow)?' are a real pleasure to me, exactly as when you read Tit-Bits.

"It is the most diverting part of the SCIENTIFIC AMERICAN Do not suppress it."

ENGINEERING.

The War Department exhibit at the Alaska-Yukon-Pacific Exposition contains a model exhibit of the system of protecting harbors by mines which will serve to show the people of the Pacific coast how perfectly secure against the entrance of hostile ships their harbors may be made. The terrific destruction wrought by mines in the Japanese war has rendered it certain that no captain of a costly modern battleship will jeopardize a ten-million-dollar vessel by venturing into properly mined rivers or harbors.

An important agreement has been reached between the Compressed Air Workers' Union and the employers, by which, instead of being paid in proportion to the depth to which the caissons are sunk the men will be paid according to the amount of air pressure in which they are compelled to work The pay will vary from $3.50 for a day of six hours at twenty-two pounds pressure to $4 50 a day for one hour and twenty minutes' work at from forty to forty five pounds pressure

Such rapid progress has been made on the "Florida" that she will probably undergo her trials during the next two or three months. Special interest attaches to this vessel because of the fact that she is the first of the 'Dreadnoughts' designed specifically as such for our navy, and the first of our battleships to be driven by turbine engines. The 'South Carolina" and Michigan," of 16,000 tons, although they carry a "Dreadnought" armament, were originally designed to be of the "Connecticut" type.

It was recently announced by the Public Service Commission that, with a view to avoiding the objections raised by property owners to a four-track tunnel through Lexington Avenue in this city at one level, which would involve sidewalk encroachment, plans are being drawn for a double-deck tunnel with the two local tracks immediately below the street and the two express tracks immediately below the local tracks. There is an objection to this scheme from an operating standpoint, due to the longer climb necessary to reach the street from the express platforms

The announcement of the White Star Line that their ships engaged in the Liverpool service will call at Holyhead on both the eastbound and westward voyages has been followed by a persistent rumor that the Cunard Company's ships when running westward will call at Fishguard on the southwest coast of Wales to pick up the late mails from London These arrangements would result in a saving of several hours time, and in the case of the Mauretania and "Lusitania,' it would then become possible for passengers to be landed in New York on Thursday night

The launch of the replica of Fulton s "Clermont" and the arrival in New York of the reproduction of Henry Hudson s 'Half Moon,' remind us of the near approach of the Hudson Fulton celebration in New York city The 'Clermont," which was built at the Staten Island Shipbuilding Company's yards, was christened by Mrs. Arthur Taylor Sutcliffe, great granddaughter of Robert Fulton. The Half Moon," although a three-masted vessel, is but 66 feet in length. She was shipped entire on the deck of the Holland American liner "Soestdyk"

A solution of the problem of navigating streams in which shallow and deep water are alternately encountered is suggested by Mr C J Bartlett of New Orleans. He proposes the construction of a submerging ship, which is designed to carry two barges when in deep water, and on encountering shallow water will submerge, float the two barges free, and tow them through the shallower reaches. Each barge is of 1,500 tons capacity and their loaded draft is eight feet. The loaded draft of the ship is fifteen feet and in the light condition she would draw six feet.

The mere mass of the concrete floor and side walls of the locks at Gatun will be sufficient to give them great stability, but, with a view to adding a further safeguard against rupture in the event, say, of earthquake shock, the government engineers intend to reinforce the concrete by imbedding in it no less than seven thousand tons of old rail This metal consists partly of a light rail which was used during the era of French construction, and partly of more modern American rails, which have been so badly bent that they can no longer be used in the track.

The rise of Germany in the field of yachting is as remarkable in its way as the wonderful development of her merchant marine. A few years ago yachting as a sport was practically unknown in that country To-day, thanks mainly to the example and untiring efforts of the German Emperor, Germany possesses one of the finest fleets of large yachts in the world The two latest and finest of these, the "Germania" and the Emperor's new schooner built this year, are probably the two fastest vessels of their class afloat. Commenting on these facts the Yachtsman, of London, says the result of this activity has been that Germany is actually a more important yachting nation than Great Britain.

ELECTRICITY.

An electric glue heater has been put upon the market which is claimed to melt glue in thirty minutes, and to keep it at a temperature of 150 deg. for several hours after the current has been switched off.

A hydro-electric power station is projected near Wadesboro, N C., on the Rocky River, capable of producing, with the initial installation planned, 6,000 to 7,000 horse-power The site is within a mile of the new Southbound Railway and a new town is expected to be developed by the industrial facilities

A successful electric lawn mower taking power from any convenient source by means of a flexible cable, has been invented by Mr F. H Kerr of Chicago He is building an improved type of machine capable of operating plows, harrows, drills and seeders for gardens and small farms.

The largest switchboard in the world is to be installed in the New York terminal of the Pennsylvania Railroad All the switches of the terminal are to be electrically controlled from this board Work has just been started on the switchboard It is to cost $500,000

Several towns in Ohio are electric-lighted by companies which own and operate no power station, but purchase current from some central station in the district. Instead of risking the building and equipment of a power station which may not be sufficiently patronized to be profitable or waiting for the central station to reach out for the business of small country towns, companies are formed in the latter owning their own wires and buying power

A steam-driven power plant is being built at Galena Ill to transmit power 25 miles north into Wisconsin The first two units installed will be 1 500 and 1,250 kilowatt three-phase alternating-current generators driven by reciprocating Corliss engines. The current is generated at 2,300 volts, transformed to a line potential of 33 000 and reduced again to 2 300 or lower where necessary for local distribution This plant will supply among other places the zinc mining center at Hazel Green

One of the largest electric organs ever built in the United States is about to be erected in the Auditorium at Atlanta, Ga. It will be played from a movable four manual control 65 feet away by an 8 volt current from a specially wound generator and blown by a 20 horsepower motor direct connected to a series of fans raising the air pressure by steps either a pressure of 10 15, or 50 inches water column being available in the universal wind chest A smaller echo organ is placed at the opposite end of the auditorium which can be played either simultaneously or independently

In addition to the Pennsylvania Railroad which began to send its passengers through the Hudson tunnels on July 19th the Erie Railroad will make use of the same facilities beginning on August 2nd The schedule for the regular operation of trains calls for six minutes for the trip to Manhattan from Jersey City The six minute schedule will chop off about 15 minutes of the time it now takes the commuter to get from Jersey City to Church and Fulton Streets in New York Arrangements have as yet not been made for the use of the tunnels by the passengers of the Delaware Lackawanna & Western or the Lehigh Valley roads

Although the operation of "pay as you-enter" cars in New York has been so successful and popular as to promise the introduction of many more this will not require the 'scrapping' of hundreds of serviceable cars of older patterns The Third Avenue line has had in operation for about a month a double-truck car converted to prepayment service by the lengthening of the platforms New hoods and knee braces were required but the old vestibules have been retained. The only difference from the new cars is the absence of a division between entry and exit doors, a double sliding door extending the whole width of the car and entry being divided from exit only by the vestibule rail. The operation of the adapted car has been so satisfactory that it is proposed to reconstruct 300 more in this way

Experiments have been made in Italy to discover the best form of insulator for high-tension transmission lines which run near the sea. It is found that in the vicinity of the sea a thick layer of salt accumulates on the insulator, and serves as a conductor to cause leakage of the current to ground. The Italian experimenters have discovered that the incrustation forms chiefly on parts which are not protected from the wind and rain The ordinary insulator for high-tension purposes consists of a number of petticoats or bells, in which the salt accumulates to a considerable depth For this reason it was found best to provide an insulator with an almost flat bell which would be so exposed to the weather that the crust could not form to any harmful extent. Insulators of this type were used with perfect success over a period of eighteen months on a 25 000-volt line. Under tests in the laboratory they withstood 75,000 volts dry, and 30,000 in a heavy rain.

SCIENCE.

The teaching of cooking is a science in Germany, as is everything else in that Teutonic empire. Traveling cooking schools are now sent about, for the purpose of instructing peasants how to cook cheaply and well. Since country people cannot go to school the government will send schools to them These traveling kitchens are now established in Hesse Nassau Franconia and the Palatinate as well as in Bavaria

Metchnikoff, in The Prolongation of Human Life,' blames the lower intestine for most human diseases, and consequently for our early death Dr Distaso of Paris not only agrees with him but even advocates the entire removal of the large intestine in childhood in order to ward off old age as long as possible Distaso claims to have confirmed Metchnikoff s statements that the large intestine is the breeding place of most harmful germs.

Some idea of the general use of false teeth may be gathered from the statement that 20 000 000 of them are exported from America to England every year When we consider that probably not more than half the inhabitants of Great Britain indulge in the luxury of false teeth no matter how many grinders they may have lost these figures would seem to indicate that nearly everyone in England suffers from defective or missing teeth As far as observation goes the United States is no better off than England in this respect

The Academy of Sciences of France has awarded a prize of $140 to Prof E W Brown of Yale University for his researches relating to the theory of the moon The sum of $200 has been awarded to Lieuts Jaence and Colin for their improved wireless telephone Out of the sum of $20 000 settled upon the Institute by Prince Roland Bonaparte the sum of $800 has been set by for the encouragement of researches by Prof Cayeux of the School of Mines University of Paris, for the particular object of enabling Prof Cayeux to proceed to the United States and continue his remarkable researches with reference to deposits of ancient minerals

Prof. W P Bowen of the Michigan State Normal College presents a most helpful exposition of what constitutes fatigue in Hygiene and Physical Education and what counterfeits it Some people are evidently simply born tired There is much misinformation as to what fatigue is It is not simply a feeling of uneasiness' and discomfort There is a motor as well as a sensory side which is even more important Some of the counterfeits of fatigue are drowsiness weakness and discomfort from breathing bad air, aversion to work termed *ennui* by the French *Mudigkeit* by the Germans lack of suitable food loss of sleep faulty nutrition indigestion adenoids and the early stages of many diseases One of the commonest forms of fatigue in children arises from the suppression of natural activities by the maintenance of one position for long periods

As a result of archæological studies pursued during many years J Prestel claims to have discovered the essence of the method employed in the manufacture of ancient Roman pottery (*terra sigillata*) and its homogeneous glaze According to Herr Prestel the secret lies not in the chemical composition of the paste but in the treatment applied to it and to the colored glaze The clay was prepared by aging followed by washing kneading and stamping Before firing the ware was exposed to the sun and air but sheltered from rain until it appeared quite dry The frequent changes of temperature and humidity and the alternation of sunlight and darkness which occurred during this slow process of drying insured uniform shrinkage in firing and durability of the finished ware When a glaze was used it was applied to the moist ware immediately after the latter was shaped so that the glaze became intimately united with the body of the ware during the slow drying process. Firing then produced a brilliant gloss and imperishable colors

Dr L. A. Bauer has raised the question whether magnetization alters mass His observations were made upon bar magnets in both the magnetized and demagnetized states and in various orientations with respect to the earth s field It is obvious that if there be local disturbances of the field the weighings may give different results for different positions of the magnet since it is not simply the force of gravitation which is being measured, but in addition the magnetic forces which act upon the bar Experiments conducted by Dr Morton G Lloyd seem to indicate that magnetization to a flux density of 17500 gausses does not alter the true weight of the specimen by as much as one part in 15 000 000, certainly not as much as one part in 8 000 000 If we make the usual assumption that mass is proportional to weight we may say that within the same limits the mass is not altered Since in Dr Bauer's experiments the flux density was probably not in excess of 3,500 gausses and since the difference found by him amounted to more than one part in 1 000 000 it is necessary to conclude that these differences are due to other agencies.

BASEBALL AT NIGHT.

The experiment of playing baseball by night was successfully made recently in Cincinnati As may be supposed powerful searchlights were employed to illuminate the baseball field The Cincinnati National League Baseball Park, where the first game was played was encircled with 100-foot steel towers, each carrying two extremely powerful carbon lamps capable of illuminating the entire park Every corner of the field was brightly illuminated

Although we have been unable to obtain engineering data on the construction of the lamps we are informed that the carbons alone are 1¼ inche in diameter Three lamps were found almost sufficient to illuminate the park but to make the undertaking absolutely successful fourteen lamps were employed to cast their rays upon the grounds Three-phase current was supplied by a 250-horse-power 60-cycle dynamo having a speed of 345 revolutions per minute The voltage is 235 The amount of current generated was enough to run twice the number of lamps for which reason huge rheostats are employed to take care of the excess Two of these powerful lamps are mounted behind each fielder Others cast their rays from the roof of the grand stand and the covered bleachers The inventor of the lamps is George F Cahill who has taken a great interest in what may be termed the mechanical improvement of baseball playing He is the inventor of an ingenious baseball pitching machine which has been used with success

ONE OF THE POWERFUL PROJECTORS.

BASEBALL AT NIGHT.

* * *

The Collateral Value of Sanatoria.

BY JOHN B HUBER A M M D

Bodington began in Sutton Coldfield England an institution for the treatment of consumption on principles natural rational and successful He insisted on generous diet fresh air day and night, the air within the house was to be as pure as that without nor could it ever be too cold for a consumptive patient Here then was established in 1840 probably the first tuberculosis sanatorium in the modern sense Its fate? Bodington was regarded as a lunatic he was contemptuously opposed by many a colleague, his patients were driven from his institution, which he thereupon turned into an asylum for the insane, in which we now believe many of his neighbors might fittingly have found an abiding place

Next in the history of santoria comes Brehmer who, having been attracted by the ideas of that obscure country doctor in England determined with true Teutonic stubbornness upon making them enduringly effective Like Bodington Brehmer had to endure the lot which so frequently falls to genius and altruism he also met with much opposition and ridicule but he persisted until he convinced both his profession and the laity of the soundness of the methods he elaborated The result is the institution established at Goerbersdorf in Prussian Silesia which has from small beginnings become of world wide beneficence and influence It is due to Brehmer's grit that we have now tuberculosis sanatoria over all the civilized world

Since this inception of the work the building of sanatoria has oftentimes, though not always been accomplished despite opposition virulent and most discouraging to those who would believe that our race has really advanced in human emotions Yet demonstrably the properly conducted sanatorium can hurt no one on the contrary it is beneficent from every conceivable viewpoint A great deal of phthisiophobia'—from which arises opposition to sanatoria—is based upon ignorance of the nature of infection in tuberculosis Such infection is not air-borne as in scarlet fever or measles Practically speaking, it is conveyed from the consumptive to his fellow human beings only through the sputum. And when this sputum is properly disposed of there is no danger of tuberculous infection. With regard to the danger of infection to the community in which a sanatorium is placed we have but to cite the experiments made at Saranac Lake, where Trudeau established the first American institution upon the modern principles of phthisiotherapy All the dust in a room of one of the cottages occupied by consumptives was gathered and a culture made from this dust was when injected insufficient to cause tuberculosis in a little guinea pig A scientifically ordered sanatorium rather than a menace to any community, is on the contrary a decided influence making in it for healthful living in every possible meaning of the term Its neighbors learn to spit less to keep their windows open day and night to live the hygienic life generally The tuberculosis sanatorium has invariably raised local health standards

In the sanatorium the consumptive gets well under circumstances the best for all concerned While there he does not infect his family, his fellow workmen, and his community, when he leaves he goes forth as a missionary disseminating the precepts of sanitation and prophylaxis he has imbibed The only trouble is, there are not and probably never will be enough of these institutions to accommodate all the sufferers from this disease, as it is now, only about five per cent can be treated in sanatoria The rest must get well—and it is quite possible for them—in their own homes.

In the merely commercial sense the sanatorium is a factor decidedly not to be ignored The rural citizen may begin with fighting its establishment in his vicinity, but give him a little time, and he will probably reason as follows The sanatorium patients are treated in such manner that so many dozen eggs are required for it every day, also so many hundred quarts of milk, so many pounds of butter, so much cereals, meats in proportion. And where or how could the sanatorium managers get these staples better than from the farmer folk in the neighborhood? If now it is explained to him that the prosperity, for example of Goerbersdorf has trebled, as has also its population, since the beginning of Brehmer's work, the ruralite will probably begin to "sense" the wherefore of this, then, no doubt, he will throw away the stick he has been whittling, shut up his jackknife and conclude that, for his part, the building of the contemplated institution need not be delayed

In point of fact, rather than being detrimental, the sanatorium actually causes real estate values in its locality to rise. The National Association for the Study and Prevention of Tuberculosis has gathered from twenty two States, covering every section of our country, convincing data to this effect The Survey (June 19 1909) has summarized these reports Over 67 per cent of the sanatoria have exerted a favorable influence on surrounding property, and in almost as many cases their effect in raising assessable valuations has been direct and measurable. In most of the other instances no differences were observable, in only three localities was it claimed that residents had been repelled In the neighborhood of a sanatorium at Portland, Ore, land has more than doubled in value in three years, the greater demand being close to the institution At Aiken S C land in the vicinity of the sanatorium has quadrupled in value since it was built, at Asheville, N C, vacant lots near one of the sanatoria sell at four times their price in 1900, and others farther from the institution but nearer the city, are less valuable, in Hebron Me the advance has been 20 per cent. Like results are reported from Luzerne, Pa. Liberty and Saranac Lake N Y Pittsford, Vt, Mt Vernon, Mo and Silver City, N M

In these places the sanatoria form an important part of local business and it would hardly be fair perhaps to make them criteria, nevertheless the effects on values are the same in the big cities—New York, St. Louis, Philadelphia, Brooklyn, Boston Pittsburg Not a single instance was reported where the presence of a santorium camp, or dispensary in a large city has had a detrimental effect on the value of nearby property And the courts of Massachusetts, North Carolina, and Virginia have decided that a tuberculosis sanatorium is not a menace to the health of a community, or to the property in its vicinity

Finally, the fact that any given locality is selected as desirable for the establishment of a sanatorium in it makes for a guarantee and an advertisement that it is a salubrious region, health resorts get built around it, private cottages are erected Would the Adirondacks, for example, have become so extensive and profitable a summering place had its destinies not been shaped in Saranac Lake?

* * *

Electric freight locomotives have been ordered by the New York, New Haven & Hartford Railroad for trial on its main line.

THE FIRST ATTEMPT AT A CROSS-CHANNEL FLIGHT AND NEW FRENCH CROSS-COUNTRY RECORDS.

After meeting with so much success in flying over *terra firma*, it is little wonder that some of the leading French aviators wished to attempt to fly across the English Channel—a distance of but 21 miles—to England, in view of the prizes, amounting to $7,500, that have been offered for this feat.

Hubert Latham, the successful driver of the Antoinette IV' monoplane, after elaborate preparations, attempted the trip early in the A. M of July 19th, and our frontispiece this week shows him leaving the cliff at Sangatte (near Calais) and also flying above the Channel Unfortunately the motor stopped after the monoplane had been in flight about eight minutes, and the machine came down in the sea. As the water was not rough, and as the built up wings of the monoplane were air tight and covered with water proof material the machine floated gently upon the waves until picked up by the French torpedo boat destroyer 'Harpon," which had been sent out ahead for this purpose Latham was found at ease in his seat, smoking a cigarette The monoplane was somewhat damaged in getting it aboard the destroyer, but as soon as it was brought ashore arrangements were made to repair it, and Latham stated that he would try again on the 23rd instant. M Louis Bleriot, whose cross-country monoplane record of 33 miles we reported in our last issue shipped his machine to Calais with the intention of making an attempt before Latham could get his machine repaired but owing to bad weather he was unable to do so Count de Lambert is also about to try to cross with a Wright aeroplane On the same day M Paulham with a Voisin biplane fitted with a Gnome revolving-cylinder motor, made a flight from Arras to Douai a distance of 20 kilometers (12¼ miles) in 22 minutes or at an average speed of 37 2 miles an hour The day before he beat Wilbur Wright's 360 feet height record by rising to a height of 450 feet

On July 23rd Henry Farman with his new biplane, made the longest cross-country flight thus far recorded Starting from the parade grounds at Chalons he flew to Suippes covering about 40 miles in 1 hour and 5 minutes and keeping at an average height of about 150 feet throughout the trip This flight demonstrates without question that the aeroplane as a means of transportation of individuals has now to be reckoned with Both a biplane and a monoplane have lately flown with three people aboard On a machine of the former type M Gobron carried Mme Collieux and Mr d Almeida for five minutes on July 3rd at Chalons while M Bleriot took M Fournier and Santos-Dumont on a 1 000-foot flight last month at Issy Thus it is mainly the question of a reliable aeronautic motor *that is keeping the aeroplane from being put into* immediate use both as a vehicle of sport and transport

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Orville Wright's Flights at Fort Myer.

After a week of failure to make a successful flight, as reported in our last issue, Orville Wright finally got in the air again and made a 16 53-minute flight on Saturday afternoon, July 17th The following Monday, the day that Latham attempted to fly across the channel, Mr Wright made two excellent flights of 25 and 30 minutes duration, making 25½ and 29¼ circuits of the parade ground at Fort Myer, respectively The machine made large and small circles and sometimes passed beyond the borders of the parade ground It flew at an average height of about 75 feet. On July 20th Orville Wright beat his last year's record of 1 hour and 14 minutes by remaining aloft 1 hour, 20 minutes, 45 seconds. During this flight he made exceedingly sharp turns and rose to a height of 150 feet at times. His perfect control of the machine was apparent to all The next day, after replacing the 10-tooth sprockets on the engine with 9-tooth sprockets and thereby increasing the speed of the motor from 1,200 to 1,400 R. P M., two short flights of 3 and 11 minutes were made.

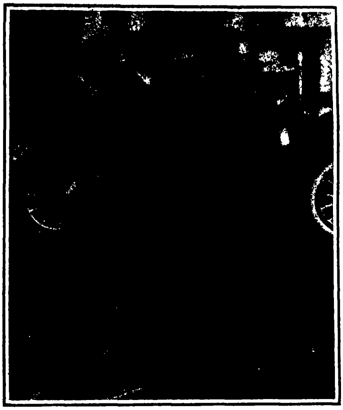
The Greatest Wireless Station.

The United States navy is to have the greatest wireless system in the world Some little time ago it placed with a Pittsburg firm a contract for the machinery necessary to generate sufficient power to send wireless messages three thousand miles The machinery is now all ready for installation but as yet there is no place to install it nor a tower high enough on which to place the equipment for sending messages so great a distance. It was suggested by one of the officials of the Navy Department that the Washington Monument be used for the purpose but the proposition was met with such a storm of protest from the public, that the idea was quickly abandoned And now the government is to build a special tower for the purpose

This tower will have a base of fifty feet in diameter tapering to eight feet at the top at which point it will be just six hundred feet from the ground level When completed it will be in a class all by itself no other wireless station ever having been built to such proportions. This tall chimney like structure will be built of steel and concrete On account of the recent development of the efficiency of concrete it was decided to use this character of material The tower, of course, will be at Washington and it will be located in Rock Creek Park and the top will be reached by a spiral stairway

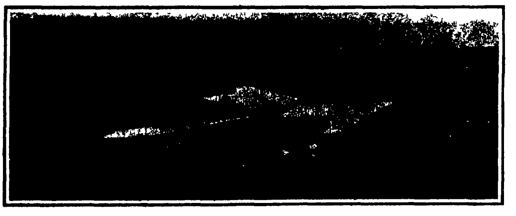
The whole scheme for building this gigantic wireless station was brought about through the Navy Department because of its desire to reach its ships at sea. The machinery for operating the station is guaranteed to deliver to all instruments keyed to receive it within a radius of 3 000 miles To-day wireless can be depended on to reach no farther than 1 000 miles and the delivery even at this distance is uncertain

The cost of the installation of the new station will be $800,000



Hubert Latham, aviator, and M Levavasseur, designer and builder of the "Antoinette" monoplane and motor

M Latham holds the monoplane record of 1 hour 7 minutes in flight, while M Levavasseur is the designer and constructor of the machine and its 8-cylinder V type water-cooled motor



Latham's "Antoinette IV" monoplane being wheeled out to the cliff for the start.

THE "ANTOINETTE" MONOPLANE, ITS BUILDER, AND OPERATOR.

A New Domestic Yeast Formula.

BY CHARLES CRISTADORO.

Statistics tell us that 84 per cent of our loaves are baked at home but 16 per cent being credited up to the commercial bakery

Every woman and baker as well has a way of her or his own of making bread As to yeast no two women as a rule, agree The sour lump of dough from the previous baking leaven is frequently used and such was the yeast brought to Plymouth Rock by the Mayflower Pilgrims Undoubtedly in New England bread in some cases is made to-day from leaven handed down from successive doughs an unbroken line of descent from the first baking at Plymouth French bread is always made from this sour dough saved out from the previous baking Yeast compressed or dried is rarely if ever used in the making of genuine French bread When bakings take place but once a week the leaven is apt to be very sour and impart an acidity to the bread not over pleasant

Housewives brew their own yeast using hops, malt, etc as do the bakers in some instances

Yeast and boiled potatoes sugar etc are brewed together and the liquid stored away and used as wanted a fresh renewal of potatoes, etc being made to the old stock Yeast of this kind is carried along year after year, and when if moving from State to State *the housewife guards her yeast jar* as she would gold

The compressed yeast cake and the dry yeast cakes have come in to lessen the yeast troubles not only of the housewife but the baker as well

Here is a domestic yeast formula that seems to surpass in reliability even the manufactured products

3 tablespoonfuls Durum wheat flour

1 teaspoonful malt extract

¼ dry yeast cake or ⅛ compressed yeast cake

Pour one teacupful of boiling water upon the flour and stir Cool to 120 deg F Add the malt extract and yeast and beat for one minute with a rotary egg beater Cover bowl put in warm place throughout the day and use at bread setting time at night

It should not take three minutes to prepare the above yeast The malt extract made by a hundred different manufacturers is in common use by all first class bake-shops and can be procured for 25 cents more or less per pint Here is the philosophy of this yeast For yeast to grow it must have air or sugar to feed and thrive upon and a warm environment preferably 80 to 90 deg F

The scalding hot water turns the raw into gelatinized starch The diastase in the malt extract inverts the starch into grape sugar and this sugar coupled with the air beaten into the dough mass by the egg beater supplies sugar and air for the yeast cells to *feed upon thrive and multiply*

The bowl of yeast is one mass of lively fermentation by evening and proves to be a yeast mixture simple economical and absolutely reliable

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A paper on 'Inductance and Resistance in Telephonic Circuits was read by Dr J W Nicholson at a recent meeting of the Physical Society A general formula for the effective inductance of a circuit consisting of two long parallel wires has been given by the author and is suitable for cases in which the current distribution in either wire is greatly affected by the frequency of alternation In the present paper certain important cases are examined in detail and formulæ are obtained capable of immediate use A calculation of the effective resistance is also made in each case Attention has been mainly directed to that of the simple telephone circuit in which the leads are not twisted round each other in order to annul the inductive effects of the earth and of neighboring circuits Throughout the investigation only iron and copper wires as the two extreme cases are considered The large permeability of iron completely changes the character of the effect of frequency on its self induction To all metals greatly used in practice except iron the formulæ developed for copper wires may be applied

Liquid Crystals.

BY PROF OTTO LEHMANN

The treatises on crystallography define a crystal as a solid homogeneous, anisotropic body Living organisms have curved forms, while crystals are polyhedra bounded by plane faces Organisms are soft, and the simplest organisms such as amœbæ are liquid, while crystals are rigid Curved and liquid crystals would contradict the fundamental definition of a crystal, and also the theory of molecular arrangement adopted by all crystallographers Snow and ice crystals, and other crystallites are apparently curved in form or structure Hence it was considered necessary to regard them as aggregates of very small crystals (globulites) But the author's experiments first published in 1876 prove that the form and structure of some of these crystallites are certainly curved at every point and represent states of transition to homogeneous crystals

Hence physical homogeneity must be eliminated from the definition of a crystal

Polymorphous transformation which was formerly explained as a rearrangement of the molecules must be regarded in view of the writer's discovery of the temperature of transformation as a change in the molecules themselves According to these researches, molecules of a single kind can assume only a single arrangement they cannot even form a structureless or amorphous mass or a liquid or gas Amorphous solids produced by cooling below the fusing point or by supersaturation of solutions are always mixtures of unlike molecules and for this reason they cannot grow as crystals do Amorphous solid bodies are not phases

It was formerly believed that all the molecules of a crystal are alike that a crystal is necessarily chemically homogeneous But this view has been disproved by the writer's discovery of mixed crystals and of their transition to crystalline aggregates and curved crystals

Hence chemical homogeneity must also be eliminated from the definition and a crystal may now be defined as a solid continuous phase which is anisotropic with respect to at least one property growth, for example

The necessity of retaining the adjective 'solid" appears to be proved by the polyhedral form apparently maintained in opposition to the forces of elasticity and surface tension but doubt is awakened by the writer's observations on silver iodide and especially by his experiments with crystals of ammonium oleate which when suspended in the solution flow and bend round air bubbles as if they were merely doubly refracting portions of the liquid Two of these crystals melt together like two liquid drops

The directions of extinction always correspond to the axes of the molecules for no casts or fragments are formed The molecules tend to assume the parallel arrangement (spontaneous homeotropy) but complete parallelism is prevented by the formation of twin crystals and by the walls of the containing vessel Hence an apparently crystalline fluid of this character is usually composed of many individual parts and is consequently turbid For this reason it has been confounded with emulsions but the latter do not form polyhedra or exhibit dichroism or double refraction

When the polyhedral form of apparently liquid crystals is disturbed it is immediately restored by an automatic extension The force of configuration' which thus acts cannot be elasticity but must result from the tendency to expand which is due to the movement of the molecules The expansion is anisotropic because the molecules are anisotropic The anisotropy of the molecules is shown also by their parallelism to the line of flow (forced homeotropy) when the mass is mechanically deformed and by their arranging themselves perpendicular to two panes of glass between which the mass is pressed or even to one pane of glass to which a thin layer adheres (pseudo-isotropy)

Hence the word solid must be eliminated from the definition for there are really liquid crystals

Liquid crystals of two sorts can diffuse into each other and form mixed crystals This result is caused not by osmotic pressure alone but also by the attracting and directing forces acting between the molecules

There are also liquid crystals which are destitute of force of configuration and consequently present themselves as perfectly spherical freely suspended drops, but reveal their internal structure by peculiar filaments dichroism and double refraction These crystal drops are crystals which are not physically homogeneous but the directive force of the molecules of solid crystals in contact with the fluid crystalline mass may cause the formation of extended homogeneous liquid crystals which can be shown by the ordinary optical methods to belong to recognized crystalline systems

The structure of crystal drops can be twisted by adding various substances These twisted drops rotate when suspended freely in a liquid which is warmer below than above Some of them produce an exceedingly great rotation of the plane of polarization Others are pseudoisotropic or are composed of very numerous discrete lamellæ of equal thickness.

It is possible to produce an indefinite number of forms intermediate between solid crystals and crystal drops, as fluid as water

Hence a crystal must be defined as a continuous phase, which is anisotropic with respect to at least one property

It is even possible for two fluid crystalline modifications of the same substance to exist, separately or mixed in proportions which vary with the temperature The two kinds of molecules are then in a sort of chemical equilibrium similar to that of dissociation Their proportions can often be recognized by the magnificent colors which are seen by reflected light or between crossed Nicol's prisms These colors have not yet been completely explained

On contact with air bubbles or drops of isotropic liquids of higher surface tension liquid crystals may spread over the surface of separation like ordinary liquids In this case the optic axes of the molecules arrange themselves normally to the surface forming hollow liquid spherocrystals or the cylindrical forms called myelinic Such are the liquid crystals of the ethyl ester of para-azoxycinnamic acid which appear as if endowed with life moving and subdividing like bacteria and other low organisms Their movements are caused by the force of crystallization which, like the muscular force of animals, is able to accomplish work by the expenditure of chemical energy without loss, and without any fall of temperature The relationship between those two forces is manifested also by the fact that a homeotropy similar to that of liquid crystals is exhibited by organisms for example in the axis of growth and the polarity of the liquid protoplasm of embryonal cells If crystals and organisms are alike in their matter and their moving forces, how can the vital spirit of an organism direct its forces to the accomplishment of a specific object? In view of the facts of regeneration transplantation auto-division and conjugation it must be admitted that spirit is divisible as well as matter that bioblasts and atoms are animated and that simple spirits may combine to form a more complex and perfect spirit The atoms whose spirits are thus united are altered and no longer obey the laws of ordinary matter In this way it becomes possible to comprehend both the directive influence exerted by the vital spirit toward the accomplishment of an object and the impossibility of spontaneous generation

The directive molecular force of liquid crystals is probably produced by electrons revolving within the molecule In fact the molecules of liquid crystals behave like astatic magnetic systems freely suspended and hence they always even in the act of flowing maintain definite directions and a crystalline arrangement

In short the discovery of liquid crystals has filled an important blank in our knowledge of the states of matter and has correspondingly modified our theories of polymorphism amorphism states of aggregation, etc The state of aggregation of the molecules cannot affect the properties of matter as profoundly as is commonly supposed From the fact that substances behave as if they were composed of astatic magnetic molecular systems and are capable of converting chemical energy into work, without fall of temperature it should be possible to deduce a quantitative theory of the structure of matter and the mechanics of atoms which will promote the advancement of physics crystallography chemistry biology and the technical arts —Translated for the SCIENTIFIC AMERICAN from Revue Génerale de Chimie Pure et Appliqué

The Current Supplement.

Much work has been done recently on the economical combustion of coal and it is possible that the average engineer is led to believe that to secure a high economy it is necessary to get a high percentage of carbon dioxide in the flue gas Mr James E Steely, in an excellent article entitled Real Relation of CO_2 to Chimney Losses shows what theoretical combustion really is, and how erratic CO_2 can be P Altpeter writes on ' Our Perception and Estimation of Areas and Distances The invention of the pantograph is historically discussed Inventions for rendering woods and textiles fireproof are described and formulæ given. The Carolina, Clinchfield & Ohio Railway which cost more than $30 000,000 to build and which involved some extremely difficult engineering work is described and illustrated at length Walter Rosenhain writes on the microscope in engineering and shows how faulty metals may be studied with its aid O Bechstein contributes an excellent article on liquefied illuminating and fuel gas Animal filters and strainers are instructively described by Dr Enoch Zander Still another interesting paleontological article is contributed by Charles F Holder the subject being 'Nature's Traps." The development of algebraic symbolism from Paciuolo to Newton is briefly discussed. Some good formulæ for colored fireworks are published. The engineering, electrical, and trade notes and formulæ are given as usual

Conviction for Perjury in Patent Case.

In the U S District Court, Oregon C A Paterson was convicted of perjury for having sworn falsely under an oath administered to him by a notary public that he was the 'original, first, and sole inventor" of an improvement in buckles, for which he filed an application for a patent. The indictment was drawn under section 5392 of the revised statutes of the United States, which provides that any person who takes a false oath before an officer competent to administer oaths is guilty of perjury

So far as we are aware, this is the first criminal conviction for swearing falsely in a patent application The presiding judge, Woolverton, in his charge to the jury drove home the importance of the oath in patent applications in the following language·

Such an oath declaration, or affidavit constitutes in part the proof upon which the Commissioner of Patents acts in determining whether or not the invention claimed is new and useful and is such a one as to entitle the claimant to a patent thereon Thus it is that the claim for the patent forms the basis upon which this inquiry proceeds and the oath, declaration or affidavit subscribed in support of the application is therefore touching a matter material to the inquiry before the Commissioner of Patents, and is such a one upon which perjury may be predicated under said section 5392 if the party taking the oath or making the declaration or affidavit swore falsely with relation thereto or if at the time of taking said oath he did not believe the matter or facts set forth therein to be true

The evidence showed that the defendant Paterson had stolen the underlying idea from the true inventor Van Emon Accordingly the jury was compelled to decide as a matter of fact whether or not Paterson was the true inventor and whether or not he conceived the idea independently

Largest Olive Ranch in the World.

Very few eastern people comparatively know that the largest olive ranch in the world is located within 25 miles of Los Angeles Cal

This wonderful orchard situated at Sylmar is ten times larger than the biggest olive ranch in Spain There are over 120 000 olive bearing trees and they average 50 pounds of olives to the tree The Sylmar ranch consists of 12 000 acres and each acre contains 110 trees which produce 2 000 gallons of olives each season This quantity of fruit makes 250 gallons of pure olive oil—valued at $2 per gallon—thus equaling $500 per acre profit

The olive wood is highly prized by cabinet makers as it is very hard and takes a high polish The Italians consider an olive orchard as a perpetual source of wealth as the older it grows the more valuable it becomes The trees are supposed to live about 4 000 years under favorable conditions There are some olive trees now on the Mount of Olives in Palestine, which are computed to be not less than 3 000 years old

The olive industry has been growing steadily in California since its first introduction by the early Spanish mission fathers, and the olive culture in that State can never be overdone, since the olive can be produced on the American continent with any degree of success only in central and southern California, New Mexico, and Arizona

The Longest Pipe Line.

Pipe-line connections have been completed by which it is possible to pipe oil from the Oklahoma wells to New York harbor Oil has been started on the long journey of 1,500 miles This is the longest pipe line in existence in the United States, and indeed in the world It is not probable that much oil from the mid-continent district will be brought to the seaboard at present, and the completion of the line seems to be more in the nature of a provision for the future, or for emergencies which may arise Oklahoma has the most active oil field in the country at present moreover its production is increasing while that of Pennsylvania and West Virginia is decreasing It may not be long before the western wells will be called upon to supply the seaboard and export demand —American Machinist.

* * *

A correspondent in Troy, N Y, draws our attention to the fact that our mention, in a recent issue, of the New York State Barge Canal as extending from Buffalo to Albany is misleading, since the canal actually connects with the Hudson River at Troy, just above Albany The citizens of Troy are hopeful of securing the sanction of Congress for a 400 foot channel in the Hudson to their city, and hope to make extensive waterfront improvements in preparation for the completion of the canal.

Correspondence.

A FORGOTTEN GUN.

To the Editor of the SCIENTIFIC AMERICAN

In one of the sporting magazines I read an article dealing with the various devices used in the transition from the flint to the percussion lock gun. About sixty-five years ago I saw a combination flint and percussion lock gun. While the flint lock was even at that date being superseded, many flint-lock double-barrels were in use. At a shooting match on the outskirts of Edinburgh this gun was used. In each hammer the flint was removed and a piece of bent steel was inserted so that in firing it struck the flash pan close to the vent. The detonators were made very much like the tags on shoe laces. The fulminate was placed in one end, which was closed, in the open end a few grains of powder, closed with a little pellet of wax. When loaded the detonating tags were inserted in the vents It never missed fire and really was the forerunner of the friction primer still used in many field guns. No mention of this style of gun has been made. It was superior to the old pile lock

Ames, Okla. W B. WILLIAMSON

HOW THE PEACE COULD BE KEPT INTERNATIONALLY.

To the Editor of the SCIENTIFIC AMERICAN

I have read with interest your article "To Keep the Peace" in your issue of May 29th, and I think that both you and Mr Dutton are mistaken in thinking that it would require an international army to enforce the edicts of a court The same object could be more effectually accomplished by a decree of absolute non intercourse until the offending power submitted to the decrees of the tribunal

To make my meaning clearer I will suppose that at least at the start, all the nations adhering to the tribunal have disarmed (Of course nothing could be accomplished unless all the great powers became parties to the agreement to submit their differences to the court.) Now let us suppose that a power Germany for instance, should refuse to arbitrate with France and should hastily summon such men as she could get together and invade France

In this case, both parties having disarmed France would be in at least as good a condition to defend as Germany to attack But let us suppose that the minute Germany takes this course, the tribunal issues an order of non intercourse, viz, that no mails, no telegraphic communication, no commerce no passengers shall be allowed to leave or enter Germany, in fact that no intercourse of any kind shall be held with the rest of the world Would not the citizens of Germany be the first to insist that its government should submit to the decrees of the tribunal—in fact, much more quickly than it would be forced to do so by any armed force, which would be difficult to transport to the place needed, difficult to provision and perhaps be defeated by the forces of the power it was trying to coerce? H. W BARTOL.

Nice, France.

SPEED OF THE "MAURETANIA"

ENGINEER MASTERS OR MASTER ENGINEERS.

To the Editor of the SCIENTIFIC AMERICAN

As regards the relative position or authority of the master and chief engineer on shipboard to-day, as discussed in your recent issue under the caption 'Speed of the Mauretania',' let me point out that if we look at the conditions obtaining about forty-seven years ago, when the "Scotia," the last of the Cunard sidewheelers, was built, the responsibilities of the master were at least equally as onerous as those of the chief engineer. Sails were also carried in those days, and here is a well-authenticated story I often heard when a boy, that the Cunard company paid the master a bonus for every lower topsail that was fairly carried away by the wind, and old Commodore Judkins obtained this bonus several times while in charge of the "Persia," and subsequently in command of the "Scotia." But if we come to more recent times, and look at such a steamer as the Inman "City of Berlin" built by Caird in 1874, we shall see that the engineer's duties were not augmented, while the master's were, or would have been had the conditions or circumstances under which he then navigated the North Atlantic been known and realised by him. The 'City of Berlin," now the U S transport "Meade," is 488 x 44.2 x 34.9 to top of "floors." Now, from the plans I have before me, this makes her practically 37 feet molded depth. This exceeds eight-tenths of the breadth. How it is that she did not follow the "City of Glasgow" and the "City of Boston" under the exigencies of hurried loading in the North Atlantic trade is a miracle. Since becoming a United States vessel she has no doubt been carefully handled, and I may point out that no matter how deep the ship is, she can be rendered perfectly stable by judicious loading, and probably her master was aware that she was lacking "stability of form." This, however, was his burden, if he knew it.

But to return to the engine room The "Berlin" had a low pressure cylinder of 120 inches, or 10 feet, in diameter, the largest that ever floated, but the revolutions of this engine were only about 54, giving a piston speed of not over 600 feet per minute Then the auxiliaries were very few No ballast pumps, no dynamos, no economizers or feed heaters, no forced draft. She had a surface condenser, but the air, circulating, bilge, and main feed pumps were all a part of the main compound engines and she had not more than four deck engines, so in this department the engineer's work was comparatively light but he did not know it. Looking at him at work you would have thought that the whole weight of the universe was on his shoulders.

But the master in those days had to consider the sails, freeboard, and stability Unfortunately however, for many thousands of people, this latter he did not understand He took charge of whatever the owners gave and they in turn trusted the shipbuilders and classification societies. This seems to show that the master of forty or more years ago had a greater variety of work than the master of a great mail steamer has to-day while the engineer's work was more limited In a great turbine-propelled steamer there may be some surcease of labor in connection with the propelling engines but the number of auxiliary engines is vastly increased In some ships instead of ten or a dozen donkey engines there are about a hundred of such, and nearly two hundred cylinders, the operating and repairing of which the average master knows little or nothing about Then more work has to be got out of the boilers by forced draft and higher pressure From all this it appears to me that in the near future the executive officer on a great steamship, instead of being the master of the engineer will be an engineer master

Cleveland, O J R. OLDHAM, N.A.M.E.

CONSTRUCTION OF AN ELLIPSE.

To the Editor of the SCIENTIFIC AMERICAN

Having recently had occasion to perform an "envelope" construction for obtaining an ellipse, I made reference to your issue of August 25th 1906 (page 135) in which J H G gives the following envelope construction for drawing an ellipse when the axes are given

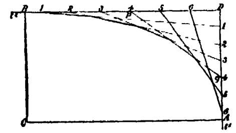


Fig 1

Let CA, CB be the axes of the required ellipse Complete the rectangle $AOBD$, divide DA and DB each into 13 equal parts and draw lines as shown each of which will thus be a tangent to the required ellipse

Now I wish to point out that the above construction is incorrect or at least that it is only a rough approximation for the lines in question are not tangents to the ellipse having the given lines as principal semi-axes

First. Let $a\,b$ denote the magnitudes of the semi axes. The equation of the ellipse is then

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$$

The condition that the right line $y=mx+c$ may touch this ellipse is that

$$c=\sqrt{a^2m^2+b^2} \qquad (1)$$

c being the intercept of the right line on the y-axis, and m the tangent of its inclination to the x-axis Now consider the line 4, 4 The co-ordinates of the points p and q through which it passes are respectively $\left(\frac{7}{13}a, b\right)$, $\left(a, \frac{5}{13}b\right)$ Its equation is, therefore,

$$\frac{x-\frac{7}{13}a}{a-\frac{7}{13}a}=\frac{y-b}{\frac{5}{13}b-b}$$

Put into the form of $y=mx+c$, this equation becomes

$$y=-\frac{4b}{3a}x+\frac{67}{39}b$$

Here $m=-\frac{4b}{3a}$, and $c=\frac{67}{39}b$, and it will be easily verified that the condition (1) is not satisfied Hence the line 4, 4 is not a tangent. The same may be shown generally or individually for each of the other lines.

Secondly When the axes are equal this construction should give a circle the form which an ellipse assumes in this special case but that the curve obtained differs (in the case of the middle radius by as much as 4 per cent) from a true circle is seen in Fig. 2 As a matter of fact, both in this case and in the former more general case, the envelope obtained is a parabola touching DA, DB at the points t_1 and t_2.

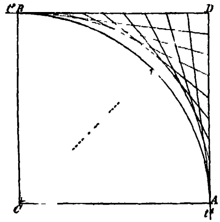


Fig 2

Thirdly An inspection of the figure in question and Fig 1 on the page of your issue referred to will at once show that the shapes of the two curves differ considerably though the ratios of the axes in the two cases are by chance the same viz 2 3 the former oval is distinctly 'squarer than the true ellipse

I append a method of accurately obtaining an ellipse by an envelope construction It is based on Brianchon's theorem which states that if a hexagon circumscribe a conic the three diagonals are concurrent, and the converse of this proposition Thus

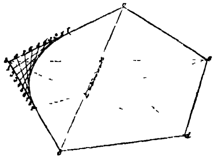


Fig 3

Let $a\,b$, $b\,c$, $c\,d$, $d\,e$, $e\,a$ be five given tangents to the required ellipse which are sufficient to determine it Join $a\,c$, $b\,d$, $b\,e$ and let the two latter cut $a\,c$ in p and q Produce $d\,p$, $e\,q$ to cut $a\,b$, $b\,c$ in t_1 and t_2, which points will be the points of contact of the ellipse with these sides. For $a\,t_1\,b\,c\,d\,e$ may be regarded as a hexagon of which the sides $a\,t_1$, $t_1\,b$ are in a straight line and whose diagonals are concurrent hence by the property stated above each of its sides touches an ellipse Since $a\,b$ can only touch this ellipse once it follows that t_1 is the point of contact and the same reasoning applies to t_2 By choosing a range of some 8 points at random in $p\,q$, and by joining d and e to each of these points in succession and producing these lines to meet $b\,t_1$, $b\,t_2$ respectively two new ranges of corresponding points are obtained when these are joined as shown in the figure a series of tangents to the ellipse which touches the five given lines are obtained The remaining corners may be taken off in a similar fashion but when the construction has been repeated for one of the opposite corners (d or e) with a little practice the rest of the ellipse can be sketched in quite accurately by free-hand

This construction adapts itself particularly well to obtaining the ellipse of gyration of an area or section in which five or six tangents are usually first obtained

Although the following point has no bearing on the above it might be of interest to some of your readers to know that meters may be reduced to yards by the same method that French pounds are reduced to English pounds viz. by multiplying by 1 1 This method is accurate to $\frac{1}{2}$ per cent.

WARWICK WORTHINGTON

Pembroke College, Cambridge Eng

Paint for Shingle Roofs.—The wood surface to be protected must be well coated twice at short intervals with hot coal tar and to this coating a thin layer of pulverized screened brick-earth applied After a few days a perfectly solid mass will have formed, which will not only protect the wood against any absorption of moisture but at the same time obviate all fire risk, as it perfectly resists flames especially if, after a few days the coating is lightly renewed and so much brick-earth applied that the tar appears quite saturated

A NEW PROCESS FOR DAMASCENING, INLAYING, AND BLENDING METALS.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN

The beautiful art of damascening the origin of which is buried in the depths of antiquity, but which no doubt hails from the East has been subjected to repeated modifications during the past few years in order to render it more commercially applicable than it probably ever was even in its halcyon Oriental days The hand wrought work so exquisitely performed at the expenditure of considerable time centuries ago is far too costly for the present age, except to the connoisseur This process briefly consisted in chasing the design upon a metallic foundation of the object to be decorated and then filling the incisions with fine wire or strips of other metal, generally silver and gold by means of a special tool, the whole finally being smoothed and polished In order to render the inlay as immovable as possible, the recesses were undercut, so that the decorative metals were in reality dovetailed into the main fabric.

Prayer book cover in copper inlaid with zinc

Such a delicate operation calls for remarkable skill and patience combined with a sensitive hand, and for this reason cannot be executed by machinery Yet at the same time there prevails at the present day a widespread demand for metal inlay work, and various methods have been evolved for the more rapid and cheaper accomplishment of the work, such as the ether parcel, or close plating fusion, electrical, and lead processes Recently however, attention has been centered in the new system of inlaying and ornamenting metallic surfaces that has been perfected by Mr Sherard Cowper-Coles the well known British electro-metallurgist which possesses great commercial possibilities, owing to the exquisite character of the work combined with the rapidity and cheapness with which it can be carried out

This process is based upon a discovery made by the inventor some five years ago during a series of experiments upon which he was engaged in connection with the annealing of iron In the course of these investigations he found that metals in a fine state of division that is in the form of powder when raised to a certain temperature which was actually several hundred degrees below their melting point, in contact with a solid metal volatilize or give off vapor, which condenses on the solid metal immersed in the powdered metal Recently the inventor in following up the discovery has turned it to distinct advantage for decorative work the results of which are similar to damascening but with the additional and important advantage that there is no possibility of the metals so blended together subsequently becoming separated as is often the case in ordinary damascening At the same time it also enables a more extensive range of effects to be secured as a large number of metals can be blended together which previously have been impossible and alloys of many colors and tints can be obtained in one operation of baking Moreover the thickness and depth to which the metals are to be inlaid and onlaid can be controlled at the will of the operator

The process is exceedingly simple The article to be decorated is first covered with a stopping-off solution about the consistency of cheese, and can thus be easily cut with a knife. The design of the desired inlay is then executed upon this composition by means of a specially designed tool having a sharp edge.

Oven in which the damascening is done.

The articles to be decorated are covered with metal dust and then heated to the required temperature.

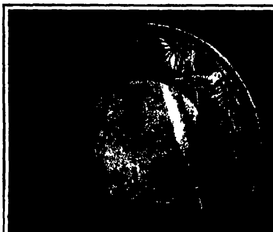
Copper tray covered with the stopping-off composition ready for baking.

Those portions to be removed are then lifted and cleared away leaving the surface of the foundation metal exposed This operation completed, the article is placed in an iron box containing the metal which is to be used for the inlay in a powdered form If for instance, the inlay metal is to be zinc the box is accordingly charged with zinc dust a product obtained direct from the zinc-smelting furnaces The iron re-

Copper teapot inlaid with zinc and brass

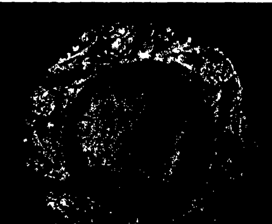
Iron box inlaid with zinc and enamel.

Copper and brass vessel inlaid with zinc.



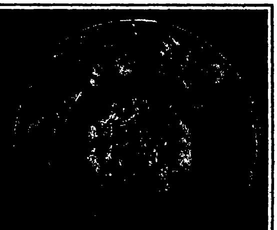
Copper tray inlaid with zinc and brass.

Foliage and birds a combination of brass and copper



Hammered copper dish inlaid with zinc.

Hammer marks show through the inlay



Copper dish inlaid and onlaid with zinc.

Onlay is raised as much as $\frac{1}{16}$ inch above the copper surface.

A NEW PROCESS FOR DAMASCENING, INLAYING, AND BLENDING METALS ceptacle, together with the objects to be ornamented and the zinc dust, are inserted in a suitable baking oven and heated to a temperature of about 500 deg Fahr, while the melting point of zinc is 686 deg. Fahr The time and temperature vary according to the thickness and depth of the inlaying which is required, and range from a few minutes to several hours. A little experience, however, soon teaches the operator the precise time and temperature necessary for obtaining given results with different metals.

When the article has been sufficiently baked, the box is permitted to cool, opened, and the articles withdrawn. Brushing with a stiff brush serves to remove the superfluous dust and also the stopping-off composition which the process of baking has loosened The stopping-off and baking processes can be repeated several times when it is desired to inlay two or more metals.

The point may be raised that the metal box containing the metal dust will in a short time become thickly incrusted with metal, but such experience has proved not to be the case, for the reason that the metal box is hotter than the powdered metal A useful type of furnace or baking oven for general work, such as panels, trays and other flat articles, is that shown in the accompanying illustration It consists of an iron vessel 8 feet in length by 4 feet in breadth and 1 foot deep The box is half filled with the metal dust, and the objects to be treated are well immersed in the powder care being observed that they are adequately covered over therewith The box is covered with a lid, and over this an iron framework is placed carrying fire bricks and provided with a small central flue to draw the heat from the burners up the sides of the box and over the top to secure even and regular heating over its whole surface Such a furnace can be constructed at a cost of about $150 complete

The damascening produced by this method is of a more permanent character than the ordinary ancient hand wrought process. It is impossible for the inlay to become detached from its foundation, for the simple reason that the two under the application of the heat become alloyed together It is also found that the inlaying metal in the case of zinc is very much harder than the brass or copper into which it is inlaid

One very notable feature of the process which is of considerable importance is that a wide variety of colors and alloys can be obtained in the one operation of baking. For instance a copper tray is to be inlaid with zinc and at the same time it is desired to convert certain portions of the copper into brass This is accomplished by varying the thickness of the stopping-off composition and by baking at a somewhat higher temperature than would otherwise be employed The result is that certain portions become converted into golden colored brass, while the other portions remain unalloyed copper The inlay work is carried out so delicately and evenly that in hammered metal objects the hammer marks in the original article will show through the inlay as if the decorative metal had been hammered in If desired, the metal foundation can possess the stippled hammered effect while the inlay has a smooth surface, thus giving a striking and pleasing contrast Some of the effects obtained are very beautiful in character The zinc inlay can be made so that it is surrounded by a fine line of brass, or be both inlaid and onlaid, in which event the latter ornamentation can be raised as much as one-sixteenth of an inch above the surface of the copper Again iron can be inlaid with both zinc and enamel which yields an attractive effect or a variety of hues produced by burning the whole of the copper surface with zinc and then etching the pattern down to the different alloys formed intermediate between zinc and brass By this arrangement the variety of tones secured is both extensive and beautifully graded It must not be thought that the effects secured are only obtainable by the use of zinc and copper Such is not the case since the more subtle shadings and hues between tin aluminium, nickel, cobalt, and other metals can be as easily produced In the photographs accompanying this article the contrasts of zinc and copper only are shown, for the simple reason that the colors possible by using other metals do not produce a sufficiently striking effect in a photograph.

Nor is the process merely confined to the embellishment of flat surfaces. It is as readily applicable to raised surfaces and objects of all shapes and sizes, such as teapots, coal vases, and other similar articles. It can also be adapted to the finest filigree as easily as to bold work, as is required in panels or heraldry An important development has been in connection with its application to book covers, the appearance of such damascened metal bound volumes being appreciably enhanced

One distinct charm about this new process and one that moreover is unique is the absence of the sharp line of demarkation as is characteristic of damascening Instead there is a soft transition from the inlay to the surrounding foundation metal That is to say where zinc is inlaid into copper the inserted metal is surrounded by a narrow band or halo of golden-colored alloy It is obvious therefore that very beautiful toned colored effects of great subtlety can be produced, ranging from silver white zinc to yellow brasses and bronzes of innumerable shades graduating to red copper and gradations of yellow and golden browns.

THE FIRST OF THE 1909 FLIGHTS FOR THE SCIENTIFIC AMERICAN TROPHY

The provisional winning for the second time on the 17th instant of the beautiful aeronautic Trophy given by this journal two years ago to further the science of aviation makes this a fitting time for us to again show it to our readers For the benefit of those who have not seen it before a brief description is herewith appended

SCIENTIFIC AMERICAN TROPHY

First competitive trial for 1909 won by Glenn H Curtiss on July 17th

Upon a globe representing the firmament Prof Langley's following-surface biplane is seen soaring through the clouds Surmounting the globe is an American eagle holding the wreath of victory in its beak The globe rests upon a whirl of clouds that rises from a base, from the sides of which spring winged horses carrying riders that bear aloft olive branches This beautiful piece of silver was presented to the Aero Club of America to stand for the highest achievement in aviation the world over At the time it was given, two years ago no one in America, with the exception of the Wright brothers had made a flight in a heavier-than-air machine, and the fact that these two aviators had at last conquered the air was not generally known It was at first proposed to hold competitions at stated times and places for the Trophy, but this was found impracticable, so that now the aviator who wishes to compete is allowed to choose his own time and place and the Aero Club will send a representative to witness the flight. The winner for any year is now the aviator who makes the longest and best flight in a closed circuit during the year

The conditions required at first were a flight of 1 kilometer (0 621 mile) in a straight line but it was not until July 4th 1908 that an attempt was made to fulfill these conditions. Upon that date Glenn H Curtiss (who had been experimenting with Dr Alexander Graham Bell in the latter's Aerial Experiment Association) made a flight of a little over a mile in the association's fourth aeroplane June Bug and was consequently declared the first winner of the Trophy In view of the flights that were being made by French aviators the conditions were then changed to 25 kilometers (15½ miles) in a closed circuit The first of the present year the conditions were changed as above stated 25 kilometers remaining as the minimum distance to be flown This is 5 kilometers (3 1 miles) more than is required in the international contest for the Bennett trophy and $5 000 cash prize which is to be held at Rheims France on the 29th of August

After having built and delivered to the Aeronautic Society his new biplane that he constructed expressly for this organization Mr Curtiss decided that he would attempt a flight for the SCIENTIFIC AMERICAN Trophy with this machine on July 5th at Morris Park just a year after he had won it the first time The flight was not attempted until dusk on that afternoon because of too much wind and when it was made it was merely a U shaped flight of about 1 mile The machine was then taken to Mineola L I and on July 17th another trial for the Trophy was made This was entirely successful as told in our last issue We give herewith some further particulars regarding this flight such as the times for each round of the triangular 1 313-mile course etc

TIME OF LAPS IN G H CURTISS'S FLIGHT FOR THE SCIENTIFIC AMERICAN TROPHY

		Time of lap
Start	5 23 16	
1st lap	5 25 52	2.36
2nd lap	5 28 32	2 40
3rd lap	5 31 08	2 36
4th lap	5 33 48	2 40
5th lap	5 36 27	2 39
6th lap	5 39 11	[illegible] 44
7th lap	5 42 01	2 50
8th lap	5 44 45	2 44
9th lap	5 47 25	2 40
10th lap	5 50 15	[illegible] 50
11th lap	5 52 58	2 43
12th lap	[illegible]	2 52
13th lap	5 58 40	2 50
14th lap	6 01 32	2 52
15th lap	6 04 23	2 51
16th lap	6 07 14	2 48
17th lap	6 10 03	2 49
18th lap	6 12 53	2 50
19th lap	6 15 40	2 47

Total elapsed time 52 minutes [illegible] seconds
Total measured distance 24 94 miles
Average speed 28.51 miles an hour

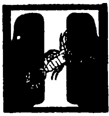
The course was triangular careful measurement made by Mr Charles M Manly after the flight showing the legs to be 2 045 2 442 and 2 446 feet in length respectively One circuit over the lines between stakes was therefore 1 313 miles but the machine of course covered a considerably greater distance as it made fairly wide turns The speed of the aeroplane was undoubtedly over 30 miles an hour The minimum distance required to win the Trophy was flown through with the completion of the twelfth lap the time for this 15 75 miles being 32 minutes and 34 seconds so that the flight was of 20 minutes more duration than was required It was only ended because of the fresh breeze that sprang up and also because Mr Curtiss feared his fuel would give out and he would not be able to land within 100 meters (328) feet) of the starting line as required in the rules He landed within 287 feet of the line

Mr Curtiss's success in flying double the distance required in the Bennett Cup race and the fact that the duplicate machine he has built to compete has a larger motor gives him a good chance of beating whatever speedy French monoplanes may be entered against him in the race at Rheims on the 29th ultimo Six of these machines—three Pelterie two Bleriot and one Santos-Dumont—and ten biplanes have been entered in the French elimination race to be held on August 22nd Three machines have been entered by England France and Italy and one each by Austria and America Some of the contests to be held during this aviation week are as follows

Grand Prix de la Champagne ($30 000) for longest continuous flight, speed test prize ($4 000) over distance of 30 kilometers, height prize ($2 000) for greatest altitude in excess of 50 meters speed prize ($2 000) for the fastest circuit of the course and passenger prize ($2,000) for carrying the greatest number of passengers 10 kilometers at the fastest speed

THE HEAVENS IN AUGUST.

BY HENRY NORRIS RUSSELL, PH D



THAT the hot weather of midsummer should be an astronomical phenomenon hardly seems possible to any one who is not an astronomer Still everyone can *determine by direct observation* that the heat comes from the sun and should be greatest when it rises highest in the sky, and shines on us for the longest time and it is easy to see how the stored up heat of early summer is carried on so that the maximum temperature falls, not in June, but in July or August

But when we ask How hot must the sun itself be, in order to send us so much heat at its enormous distance? the astronomer and the physicist must join in long and careful studies before the question can be answered In the first place the sun's temperature does not really depend on its distance at all If it was twice as far off and twice as big it would look just the same and send us just as much heat What we receive depends on how big the sun *looks* in the heavens and how bright it *really is per square mile* or square foot We can therefore compare it with substances in our laboratories, which though enormously smaller than the sun, are also enormously nearer, so that the two things balance

Now in the laboratory we find that all substances radiate heat to a greater or less degree even at the lowest temperatures we can produce Complete absence of radiation would only occur for a body at the absolute zero (i e one for which the motions of its molecules had all ceased) which can never be obtained in practice As the body grows hotter the radiation of heat from it rapidly increases However, at the same temperature some substances (such as polished metal) send out much less heat per square inch than others (such as a surface covered with lampblack)

For reasons which we have not space to detail the blackest substances (which at a given temperature send out most heat) are taken as a standard It is found that the amount of heat sent out per square inch by such a black body depends not on the particular substance but only on its temperature and that as the temperature rises the heat radiated increases as the fourth power of the temperature measured from the absolute zero Doubling the temperature increases the radiation sixteen times and so on We can find by actual experiment how much heat a black body apparently as large as the sun sends us at different temperatures and verify this law (which bears the name of its discoverer Stefan) The sun itself sends us very much more heat than a body of the same apparent size heated as hot as we can get it but by applying Stefan's law (which there is good theoretical reason to trust) we can estimate how hot we would have to heat our experimental body (if it could stand it) to imitate the sun's condition

The problem then reduces to the exact measurement of the heat we get from the sun This is difficult because our atmosphere absorbs a good deal of it and it is hard to calculate how much By working on a high mountain (so as to have less air above one) and measuring the heat which we receive from the sun at different altitudes (that is through layers of air of different thickness) the problem can be solved with a good deal of accuracy

A very careful determination using delicate electrical apparatus to measure the heat received has been made by Dr Scheiner of the Potsdam University who set up his apparatus on a mountain in Switzerland, at an altitude of 10,000 feet.

Translating his results into the units most familiar in our ordinary life, it appears that the heat which we receive from the sun (if directly overhead) per square foot would raise the temperature of a pound of water 8½ deg F per minute.

Only about half this heat reaches the earth's surface (at sea level) directly The rest is absorbed in our atmosphere and helps to warm it. Even so, a man lying on the ground in the sun's rays, and presenting six square feet of surface to them, will receive more heat in an hour than is needed to raise a gallon of water to the boiling point. So it is no wonder he is warm!

Working out the sun's temperature from his data, Dr Scheiner finds it to be 5,950 deg C., or 10,740 deg. F, with an uncertainty of about 50 deg.

This is, however, the temperature which would give us the observed radiation if the sun was a "perfect radiator," and had no absorbing atmosphere. As a matter of fact all known substances have to be heated somewhat hotter than this theoretical temperature before they give out the same amount of heat. Also, if the sun's atmosphere stops some of his heat, the radiation from, and the temperature of, his actual surface must be greater than the *minimum* value here determined How much allowance must be made is a matter of judgment. Dr Scheiner estimates the actual temperature of the surface (if a good radiator) at 6 800 deg C or about 12,250 deg F

The highest temperatures attainable by artificial means (in the electric arc and furnace) are about 4 000 deg C or 7 000 deg. F

The sun's surface temperature, though higher than we can produce experimentally, is hardly of a different order of magnitude What the internal temperature may be we can hardly even conjecture, for we know too little of the properties of matter under conditions so far removed from our experience.

THE HEAVENS

The most characteristic of the summer constellations is perhaps Scorpio, which can now be well seen on the southern horizon. It is the finest of the twelve zodiacal constellations, but we never fully realise its brilliancy for a great part of it rises but a few degrees above our horizon As our initial letter shows, the resemblance of the constellation to the creature for which it is named is remarkably good

The great red star Antares is at the Scorpion's heart, its head and claws extend to the conspicuous vertical line of stars β, δ, π (in fact they once occupied a large part of what is now attributable to Libra) and the long, recurved tail sweeps down to the horizon and ends with the bright star λ, which might be called the Scorpion's sting.

Several individual stars are noteworthy β and ν are fine doubles, which are resolved into multiple systems by powerful telescopes. Antares itself has a close companion, less than 1/100 as bright as its primary, and very green. This is one of the finest pairs in the heavens, but is too difficult for small telescopes, unless the air is exceptionally steady μ is a naked-eye double, though hard to separate except on a very clear night, and one of the components is a spectroscopic binary, remarkable for the great mass and orbital velocity of the two bright stars which compose it.

To the left of Scorpio we see Sagittarius, with the familiar "Milk Dipper" (composed of the stars λ, φ, σ, τ, ζ) The magnificent star clouds in the Milky Way, which lie in this region, can now be seen at their best.

Capricornus, with the naked-eye double α, is in the southeast, and Aquarius is rising on the left. The great square of Pegasus is almost due east, and Andromeda is in the northeastern horizon. Cassiopeia is higher up, then Cepheus, then Cygnus, nearly overhead South of this are the small groups of Sagitta and Delphinus, then Aquila, with the bright star Altair Vega is almost exactly overhead, a splendid mark for the zenith. Due west is Hercules, then Corona, then Boötes, with the ruddy Arcturus. Ophiuchus and Serpens occupy the upper part of the southwestern sky, and Libra and Virgo the lower Ursa Major is in the northwest, and Draco and Ursa Minor in the north, above the Pole.

THE PLANETS.

Mercury is in conjunction with the sun on the 4th, and is invisible during the first half of August. Toward its end he can be seen just after sunset, but not as well as next month On the 25th he is very near Jupiter, about 1 min south of him, and should be easy to pick up

Venus is likewise evening star, setting about 8 P M. On the afternoon of the 12th she is in conjunction with Jupiter At 2 P M they are but 12 min. of arc apart, in the same telescopic field By nightfall in America they will have separated a little, but their distance will still be less than the moon's apparent diameter This close approach of the two brightest planets is well worth watching.

Mars is in Pisces, rising about 9 45 P M. on the 1st, and 8 P M on the 31st. He is very conspicuous, and will be an object of assiduous telescopic study, though his nearest approach to us does not occur till next month.

Jupiter is evening star in Leo, setting about 8 P M. in the middle of the month.

Saturn is in Pisces, about an hour east of Mars, and rises about 9 30 P M. on the 15th.

Uranus, which passed opposition last month, is in Sagittarius, well placed for observation. On the 15th he is in R. A. 19 h. 17 m. 30 s., dec. 22 deg. 44 min south, and is moving 8 s. westward and 15 s. southward per day

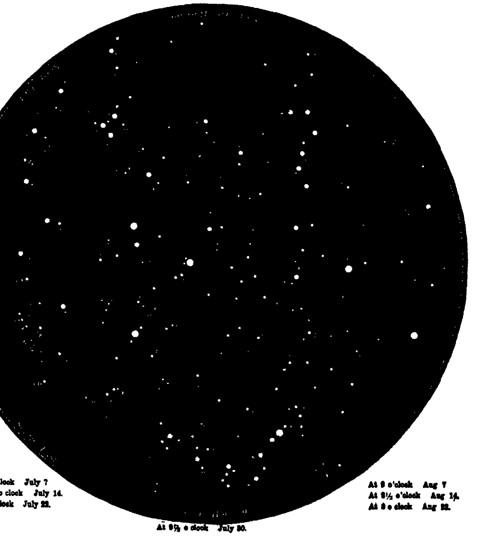
Neptune is in Gemini, observable, if at all, only in the early morning.

THE MOON.

Full moon occurs at 4 P M. on the 1st, last quarter at 8 A. M. on the 8th, new moon at 7 P M. on the 15th, first quarter at 11 P M. on the 23d, and full moon once more at midnight on the 30th.

The moon is nearest us on the 3d, and farthest off on the 19th. She is in conjunction with Mars on the 5th, Saturn on the 6th, Neptune on the 12th, Mercury on the 16th, Jupiter on the 17th, Venus on the 18th, and Uranus on the 27th.

A faint comet was discovered by Mr David at the Princeton University Observatory about the middle of June. Details of its orbit are not yet accessible to the writer.



At 11 o clock July 7
At 10½ o clock July 14.
At 10 o clock July 22.
At 9½ o clock July 30.
At 9 o'clock Aug 7
At 8½ o'clock Aug 14.
At 8 o clock Aug 22.

NIGHT SKY: JULY AND AUGUST

Handy Man's Workshop

HOW TO MAKE CONCRETE POTTERY—IV

BY RALPH C. DAVISON

(*Continued from the issue of July 17th*)

The method of making plaster molds for circular objects is somewhat similar to that described for making square or oblong molds in the last article Instead of making the outer mold in two pieces, however, as described for square work it is always better to make three pieces, as illustrated in Fig 14, for the reason that in making three pieces the liability of having an undercut or overhang on one of the halves of the mold is entirely obviated When two pieces only are made unless the mold is cut or parted exactly in the middle there will be an undercut on one piece of the mold, which would prevent the mold from freeing itself from the finished cast. By referring to the dotted lines in Fig 1, the meaning of an undercut will be made clear The distance *a* is less than distance *b* and so the part *c* can not be removed The method of making this outer mold is the same as was used for making the outer mold for the square form, excepting that as above stated there are three pieces instead of two to be made

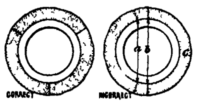


Fig 14.—CORRECT AND INCORRECT METHODS OF DIVIDING THE OUTSIDE MOLD

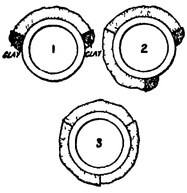


Fig 15—SUCCESSIVE STEPS IN MAKING THE OUTSIDE MOLD

The position of the modeler's clay and the various steps in the construction of the outer mold is clearly shown in Fig 15 Shellac and oil the edges of each section before coating the next The sides of the concrete or cement cast if the object is of any size at all should be at least one-half inch thick, and therefore the core, which is to be composed of four pieces, as shown in Fig 16 at *A*, *B*, *C* *D* should always be at least one inch smaller in diameter than the inside diameter of the outside mold The first step toward making the core is to secure a box and fit it up as indicated in Fig. 17 The tapered center of the core *D*, shown in Figs. 16 and 18, should be made first. The foundation for this can be made by winding around the spindle in the box shown in Fig. 17 cheese cloth or mosquito netting which has previously been dipped in a thin "mixture" of plaster of Paris. After having prepared the spindle as above a template should be cut from a piece of tin and secured to the box as shown in the plan view, Fig 18 The tin template should be mounted on a piece of wood, to give it strength, and the wood in turn should be secured by small nails in position on the box as shown This template should be set the proper distance from the center of the spindle, so that on turning the spindle the center of the core produced will be of the exact size and taper desired, as indicated at *D*, Fig. 16.

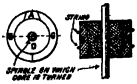


Fig. 16.—THE CORE MADE IN FOUR PIECES.

After having secured the template in the proper position mix up some plaster of Paris, as previously explained, and pour or throw it on the partly built-up core, at the same time turning the spindle by means of the handle The plaster thus added will adhere to and partly harden on the spindle. Keep adding plaster and turning the spindle until the plaster is built out to the template, which will cut or scrape it off and form it into a perfect cone. To smooth the surface of the cone, cut away all of the plaster that has adhered to the top of the template, and with your hand, which has previously been wet with water rub the surface of the cone as it is being revolved Now remove the template and shellac and oil the cone well with either heavy oil vaseline, or lard

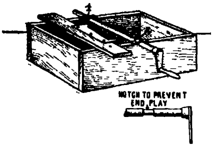


Fig 17—BOX FOR TURNING PLASTER

The next step is to turn up or form the outer portion of the core A template should be made for this and secured to the box as was done for the center of the core care being taken to locate it in the proper position from the center of the spindle so that the diameter of the outside of the core will correspond to the desired diameter of the inside of the finished piece to be made

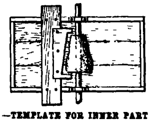


Fig 18—TEMPLATE FOR INNER PART OF CORE.

Proceed to pour or throw the plaster mixture on the center of the core, which has already been oiled and keep turning the spindle until the plaster has been built up and scraped off by the template and the desired form produced to the outer surface of the core Smooth the surface off, as was done with the inside of the core or cone, and shellac and oil it well

Now remove the whole from the box by lifting up the tin strips 1 and 2 in Fig 17, which hold the spindle in place and part the inner core *D* from the outer section of the core by jarring the end of the wooden spindle lightly with a hammer The next step is to cut the outer sections of the core which is now in the form of a continuous ring into three pieces This can be done with an ordinary wood saw, the thinner the blade of the saw the better Use water on the saw blade while cutting as this will prevent it from binding Be sure to cut the sections as shown in Fig 16 The section *A* must be wider on the inner circumference than on the outer as shown Now assemble the three pieces into which the outer section of the cone has been cut around the inner section of the core *D*, so that they are again in the same position as shown in Fig 16, fastening them

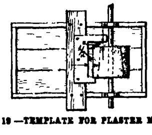


Fig 19—TEMPLATE FOR PLASTER MODEL.

Then place the core as assembled in the box again care being taken to get it into the same position as before removing from the box, securing it in place by placing the tin strips 1 and 2 over both ends of the spindle as before Shellac and oil well the outer portion of the core again and then set in place on the box a tin template mounted on wood and shaped to correspond to the outer section of the finished piece, as indicated in Fig 19

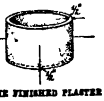


Fig. 20.—THE FINISHED PLASTER MODEL.

As we are now going to make a model in plaster of the finished piece, the sides of which must not be less than one-half inch thick the template as shown must be placed at least one half inch from the outer surface of the inner core After having adjusted the template proceed to throw on the plaster and turn it up until it is built out to the template and shaped into the desired form Smooth it off with water, and then shellac and oil Remove the whole from the turning box tap the end of the wood spindle, and if care has been taken to shellac and oil all of the parts as directed, the center of the core will fall out To remove the outer part of the core first take out the smaller piece *A* l forcing it toward the center The rest of the core will then collapse and we will have left a plaster model of the box, as shown in Fig 20 which we are to cast in cement Oil the outside of this well and then proceed to make the outer plaster mold in three pieces as already explained and as shown in Fig 15

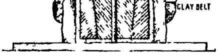


Fig 21—PARTS ASSEMBLED FOR CASTING PLASTER CASE

After having made the outer mold proceed to assemble the parts as shown in Fig 21 and cast the plaster case as was described in the last article for square objects Use a clay belt around the outer mold as shown to prevent the plaster from coming down too far The spindle must be cut flush with bottom of plaster model Before casting the case be sure to shellac and oil all parts which will come in contact with the wet plaster used in casting the case After having removed the case assemble the parts again using the case as a base as shown in Fig 22 Cut the spindle flush with the core The mold set up in this position is ready to receive the liquid cement mixture which is poured the same way as already explained in the last article

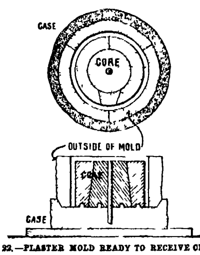


Fig 22.—PLASTER MOLD READY TO RECEIVE CEMENT MIXTURE

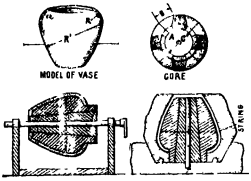


Fig 23—STEPS IN MAKING A MOLD FOR A VASE

One need not confine himself to straight-sided objects as molds for pieces embodying curved outlines etc can also be made by following the general directions given for the mold just described the only difference being in the shape of the templates used It will therefore be unnecessary to go into details as to how to make a mold for a vase shaped as shown in Fig 23 as the illustrations which show the various steps, will make it clear to one who has followed the previous directions closely It will be noticed however that there is quite an undercut at the point *a* in this vase, owing to the mouth of the vase being of a smaller diameter than the greatest inside diameter of the piece The main thing to guard against, therefore, in making the mold for this piece is the core Care must be taken to have the distance *B* shorter than the diameter of the inside core or cone *C* If this is not done it will be impossible to get the core out of the finished cast It might be well to state the progressive operations in the making of this mold They are as follows First make inner core or cone Second build up outside part of core Third remove outside part of core and cut into pieces as shown Fourth, reassemble core and place in spinning box Fifth build up and turn plaster model of piece to be cast Sixth remove all pieces from spinning box and cast outside mold Seventh cast case

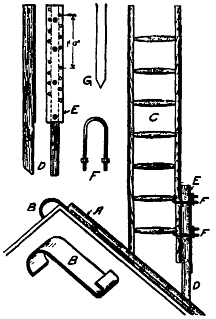
(To be continued)

A LADDER EXTENSION LEG

BY I H BAILEY

A painter or any other mechanic is sometimes called upon to paint or repair work which is very unhandy to reach Perhaps a ladder is to be supported in some manner upon a slanting roof of a shed or other building Such a case happened very recently when the following scheme was adopted by a mechanic with success

A ladder *A* was supported from the peak of the shed roof by means of a plate *B* bent in the shape of a hook Two painter's hooks would do just as well The plate *B* was about 8 or 10 inches wide and 3 feet 6 inches long before being bent The grip on the roof peak should not be less than 6 or 8 inches The second or working ladder *C* was supported on the first ladder *A* by an extension leg *D* made of 4 by 4 timber of tough quality The foot of this leg *D*, was shaped as shown in detail to fit against the rounds of the ladder on the roof A plate *E* furnished with a number of holes for a couple of U bolts *F* was screwed down to the leg *D* The holes were staggered and spaced 2½ inches apart on each side allowing adjustment of 1¼ inch each way to accommodate different pitch of roofs The distance apart of each group of holes in the plate *F* should equal the distance apart of rounds of the ladder usually 1 foot so that the rounds of the ladder will bear on the U bolts which should be drawn up tight when the proper adjustment has been made



HOW TO SUPPORT A LADDER ON A SLANTING ROOF

If the extension leg was made of steel of smaller dimension than the timber one furnished with a sharp point *G* to stick in the shingles of the roof, the ladder *A* and hook, *B* could be dispensed with

AUTOMATIC LUBRICATING CUP

BY W J O

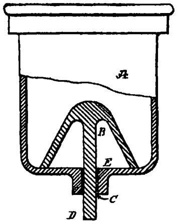
In lubricating the reciprocating parts of vertical engines there is considerable waste of oil and the lamp wick dangling from the end of the oil pipe forms a collector of dust and grit, which is carried to the bearings The waste of oil is principally through the fact that when the engine stops the oil still continues feeding and drops into the crank pit rather than into the oil cup

Much of this can be avoided by the use of an oil cup such as shown in the accompanying sketch It consists of a cup of the usual shape having inside a mushroom-shaped valve *B* which is ground to a tight seat at *E* The stem *D* passes through a clearance hole *C* in the bottom of the cup When the cup is filled with oil the mushroom valve prevents its flow as long as the engine is at rest

The cup is placed directly over the oil cup which is to receive the oil and which moves in a vertical direction By means of adjusting screws its height is so arranged that the stem of the valve is raised slightly as the oil cup comes to the top, thus allowing a small amount of oil to pass inside the valve and flow down the stem The receiving cup should be filled with horsehair, to rub off the necessary oil from the stem

The oil flows only when the engine runs, and in proportion to the speed of the engine.

No time is lost nor oil wasted in shutting off the supply when the engines are secured, and the stem can be easily wiped clean of all dust if it has remained unused for some time



AUTOMATIC LUBRICATING CUP

This cup could be used on horizontal engines by a slight modification of the stem, but on vertical marine engines as on tugs where the engine is run intermittently the writer has seen it do good service and save many times its cost in oil, labor and hot bearings

EXPERIMENTS WITH ALTERNATING CURRENT, USING A SMALL DIRECT-CURRENT MOTOR

BY F P M DERMOTT, JR.

A small direct-current motor such as can be purchased for about a dollar will operate in various ways as an alternating-current motor These methods of operation are not recommended for regular use but they serve as excellent experiments with alternating currents

A series wound motor with a three-part commutator is suitable Owing to the variety of such motors on the market only general directions can be given here leaving the details to the judgment of the experimenter If the motor is to be connected to an alternating-current circuit of about 110 volts it is necessary to have some means of limiting the current passing through the windings. The diagrams show a lamp rheostat used for this purpose The rated voltage of the lamps should not be less than the voltage of the circuit for the resistance of the motor may be so low that the lamps will receive almost the full voltage of the supply and they would then be burned out if made for a lower voltage A rheostat enabling any number not exceeding ten of 16-candle-power carbon filament lamps to be connected in parallel is large enough In determining whether the wiring and fuses through which the current is supplied have sufficient carrying capacity remember that each lamp takes about ½ ampere when supplied with its rated voltage The current per lamp will be less than this when the motor is in series with the lamp rheostat.

Make the connections to the motor with all of the lamps turned off, and start by turning on the lamps until the motor receives sufficient current. Do not turn on so many lamps that the motor attains an excessive speed or temperature

Of course a suitable step-down transformer or a reactance coil may be used instead of a rheostat.

When the motor is in proper condition to operate as a direct-current series motor, it may be operated as an alternating-current series motor With the exception of inserting the rheostat, the motor is connected to the alternating-current circuit in the same way that it is connected to a battery when run as a direct-current motor (See Fig. 1.) To reverse the direction of rotation transpose the wires connected to the brush holders, as would be done to reverse it when operating with direct current.

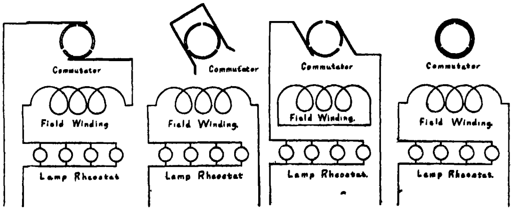


Fig. 1 Fig. 2 Fig. 3 Fig 4

DIAGRAM OF CONNECTIONS FOR THE EXPERIMENTS.

A repulsion motor consists of a stationary field magnet, through the winding of which alternating current is passed. The armature is similar to a direct-current armature. Instead of the two brushes, or, in larger machines, the two sets of brushes (corresponding to the positive and negative sets of brushes in a direct-current machine) being insulated from one another, they are connected together To run the motor as a repulsion motor, it will be necessary to shift the brushes until the proper position for operation is found. If the brushes supplied with the machine can be readily shifted then they may be connected together by connecting a wire to the two brush holders. If they cannot be readily shifted, remove them and bend a piece of copper wire into the shape shown in the diagram (Fig 2) so that it can embrace the commutator and touch it at diametrically opposite points. This wire acts as two brushes connected to one another, and for experimental purposes may be held in place by hand After the brushes have been arranged, pass current through the field winding, as shown in Fig 2, and vary the position of the brushes until the motor runs.

The inverted repulsion motor differs from the repulsion motor in that the alternating current is supplied to the armature, and the field winding is short circuited To obtain this motor (Fig 3) connect together the two ends of the field winding and supply current to the armature. As was the case with the repulsion motor, it is here necessary to shift the brushes until the proper position for operation is found If the brushes supplied with the motor can be readily shifted, supply current to the armature through them Otherwise, the current may be supplied to the armature by removing the regular brushes and pressing the wires carrying the current against the commutator at two diametrically opposite points, shifting them until the proper position for operation is found The repulsion and inverted repulsion motors are reversed by shifting the brushes.

In the single phase induction motor current is supplied to the stationary winding and the revolving part consists of a winding having short-circuited coils, or else a squirrel-cage winding.

To obtain the induction motor wrap a few turns of wire around the commutator, so that each coil of the armature is short-circuited Run without brushes, supply current to the field winding only according to Fig 4 Unlike the other motors here described, the single-phase induction motor is not self-starting unless special devices are provided to make it so When these devices are absent, as in the case here the motor will run equally well in either direction when once started Start by giving the shaft a twist with the fingers or by wrapping a piece of string around the shaft and rapidly pulling it off.

For the theory of these motors, and also the modifications in construction used to secure better operation consult textbooks on alternating currents

DEVICE FOR REMOVING BROKEN WOOD SCREWS.

BY G H SINCLAIR.

For the past fifteen years I have successfully used a tool for the removal of broken wood screws made on the same lines as the soft brick pipe drill shown in Handy Man's Workshop of February 27th, 1909

The size of the pipe needed can be obtained from the shank of the broken screw, though it is desirable that the pipe should be a trifle larger, to allow for clearance and in case the screw should not have been run straight. Any piece of brass or steel tubing can be used, while steel is better, brass is more readily obtained. After the teeth are filed, bend every alternate tooth out a trifle for clearance. Use this pipe bit, and bore out the broken off screw Glue in a plug, and you can run in a new screw, never knowing the old one had been broken.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

COLLAR.—B. S. Ellis, Troy, N Y The purpose of this invention is to provide a collar having improved means of attaching the same to the collar button at the back of the neck band, and which will operate to prevent the button at this point from coming in contact with the cravat or necktie which may be worn with the collar

EAR-JEWEL FASTENING —C Weller, Newark, N J The improvement refers to jewelry and its object is to provide a jewel fastening arranged to securely hold the jewel in place on the lobe of the ear without requiring piercing thereof and to allow convenient manipulation of the fastening when applying or removing the jewel

Of Interest to Farmers.

TROUGH —J S. Weaver and J B Weaver New Oxford, Pa This invention is an improvement in troughs such as are generally used for feeding and watering stock and has in view a trough such that the ends may be easily applied to and detached from the body and from water-tight connection therewith, whereby the parts when disassembled can be closely packed convenient for shipment and stowage.

DESICCATING APPARATUS —J Roeh Spokane, Wash This apparatus may be used for carrying out the process disclosed in a divisional application formerly filed by Mr Roeh The invention relates more particularly to an apparatus especially designed for use in the treatment of milk to remove the water therefrom and produce a powdered product

Note -Copies of any of these patents will be furnished by Munn & Co. for ten cents each Please state the name of the patentee title of the invention and date of this paper

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Cultivator R I Stalans	928 070
Cultivator attachment corn H Neff	928 146
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Iron or steel for casting preparation of F Rakowicz	927 678
Ironing table C W Dodsworth	927 841
Jar closure J R. Barranger	928 008
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Key hook N L. Thomas	928 090
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Knitting machine Wilson & Paquette 928,165	928,166
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Latches, emergency exit attachment for knob A M H[illegible]	927 651
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Lathe stocks means for securing movable C D Young	927 628
Lathe structure for the like centralizing mechanism for F Hardinge	928 045
Laundry articles marking machine for C W Carter	927 487
Leather good S Zeugschmidt	927 701
Leather or artificial patent leather making patent G R De Montford	928 [illegible]
Leather staking machine table F F Slocomb	927 690
Legging protector M H Marcus	927 980
Lens grinding machine R F Clark	927 619
Lift shirt H C Coeltz	927 619
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Liquid cooling apparatus F Bauer 927 765	927 766
Liquid dispenser S Lippstadt	928 059
Liquid fuel heating burner M Greata	927 851
Liquid receptacle locking and controlling device for J G Williams	927 621
Liquid separator centrifugal I L. Kimball	928,150
Liquids apparatus for filling receptacles with D Landau	927 983
Liquids regulator for the flow and level of I Sutherland	927 889
Lithographic stone artificially manufacture of T M Thom	927 622
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Pipe coiling machine I C Schneider	928 [illegible]
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Planer for narrow width wood C W H Blood reissue	12 990
Planter B R Langley	928 [illegible]
Planter attachment corn F Fisher	927 [illegible]
Planter attachment corn F A Jones	927 [illegible]
Planter corn D F Sinclair	927 [illegible]
Planting machine B R Langley	927,535
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Rail joint, J Fait	927,720
Rail joint, R H Marsh	927,987
Rails to metallic ties, means for securing, Berryman & Turner	928,173
Railway crossings, block system for, G W Nistle et al	928,148
Railway fastening, C H Cornell	928,231
Railway fish plate, J A Belk	927,942
Railway interdependent signal and switch apparatus, F Prochaska	928,004
Railway pleasure, F R & R. H Fageol	927,817
Railway rail tie and rail fastening, J Timms	928,008
Railway safety device, Weber & Montgomery	927,909
Railway signal torpedo, F Dutcher	928,114
Railway switch, A A Long	927,864
Railway switch lock, J O Hale	927,789
Railway switch, self latching automatic, J N W Porter	927,677
Railway tie and rail clamp composition, L C Metsch	927,666
Railway track, L. Clark	927,830
Railway track guard, H Marshall	927,569
Ratchet wrench, O M Weir	927,618
Razor, safety, C A O'Neill	927,588
Reflecting device and sound conveyer combination, I Weglein Jr	927,910
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Relay, R H Manson	927,749
Relay, F R Bruden	928,104
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Rotary engine, Wunderlich & Koerber	928,094
Rotary engine, F F Nichols	928,147
Rotary motor, Chapman & Shoemaker	927,659
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Rule joint, folding, C Bodmer	928,174
Ruling machine pen clamping device, C Burrows	927,634
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Sash fastener, C C Harlan	927,967
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Saw machine, power back, C. Rasmussen	927,751
Saw tension device, band, F T McDonough	928,211
Sawing machine, S M Krawchenko	928,130
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Seed separating machine, E. H Geise	928,120
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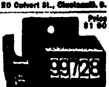

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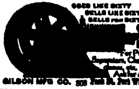

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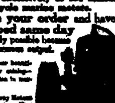

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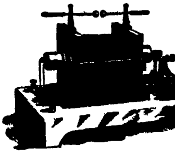

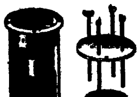

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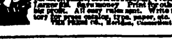

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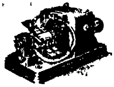

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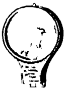

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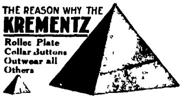

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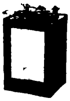

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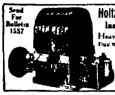

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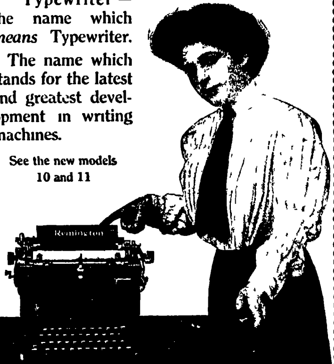

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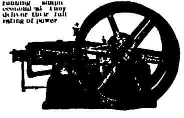

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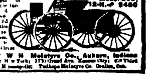

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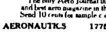

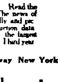

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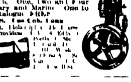

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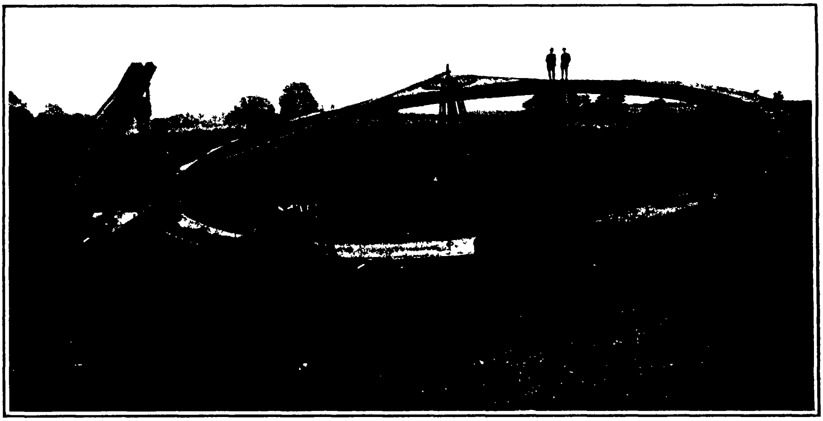
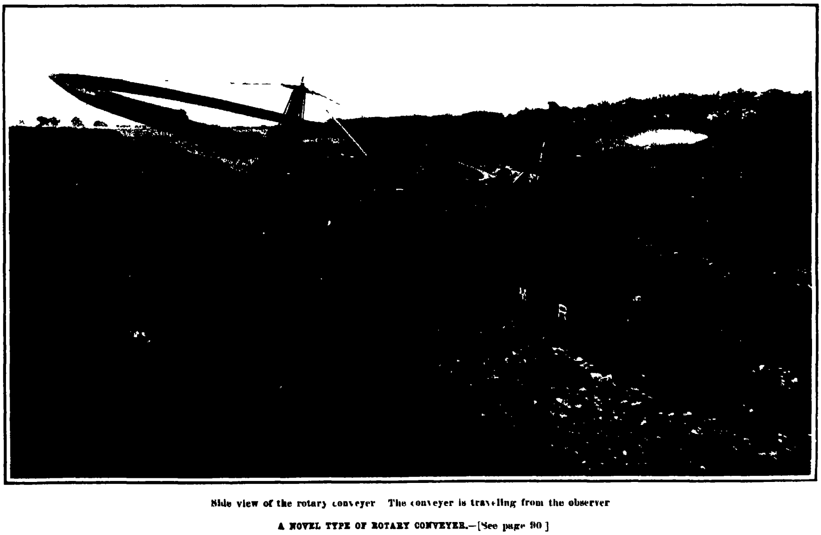


Top view of rotary conveyer, showing table of wheel and special revolving hopper for charging



Side view of the rotary conveyer. The conveyer is travelling from the observer

A NOVEL TYPE OF ROTARY CONVEYER.—[See page 90.]

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NEW YORK SATURDAY AUGUST 7th 1909

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short* and the facts *authentic* the contributions will receive special attention. Accepted articles will be paid for at regular space rates

BLERIOT'S CHANNEL FLIGHT

History is making fast these days in the world of aeronautics and the dramatic flight of Bleriot across the English Channel has set a milestone of progress which must forever be memorable No one surely would be so unjust as to belittle this great performance by reference to earlier and longer flights over the land In point of risk and daring that bold, early morning dash across the Channel stands in a class by itself Quite apart from its spectacular features there are serious reasons, well understood by the aeronaut, why a flight across a twenty mile arm of the sea, edged on either side by cliffs hundreds of feet in height is a more hazardous undertaking than a flight in a closed circle over chosen ground or even a straight-away dash across country between starting and alighting places which have been already selected In a land flight the aeroplane rises gradually from the ground the height at which the aeronaut will travel is a matter of choice and it may be attained by gradual ascent So also in landing the descent is a matter of gradual control In the cross-Channel flight however, the aeroplanist immediately after the start must launch himself out from cliffs several hundred feet high and find the distance between himself and the earth's surface increased suddenly by that amount Should his motor fail during the twenty one-mile stretch of the course he must forthwith make a swift swoop into the sea where in spite of the fact that Latham has twice been rescued the chances of disaster are very great indeed The speed of the aeroplane is so much greater than that of an attendant torpedo boat that the latter is quickly left behind and when the aeroplane is once in the water it is merely a question of the flooding of the hollow wings and central body, before the weight of the motor tanks and chassis to say nothing of the operator will submerge the whole machine

The Wright brothers have described in a paper before one of the technical societies the great agitation of the lower strata of the air caused by the uneven surface of the ground where trees hills buildings and other obstructions cause the air in contact with it should a wind be blowing to roll in billows and swirl in eddies in much the same way as the waves break on the shore or as water is thrown into commotion when flowing in a cataract over a rocky river bed Bleriot encountered these atmospheric billows as he passed from sea to shore above the lofty cliffs of Dover where his machine was described as having been driven violently from its true line of flight

The fact that the first machine to cross the Channel was a monoplane has raised the prestige of that type Throughout his experimental work Bleriot has made almost exclusive use of the monoplane and although recently he has done some work we believe with the biplane the fact that he selected his favorite machine for the great venture would seem to indicate that he considers it at least at the present stage superior to a multiplane flier On the other hand it should be remembered that the other notable success of this memorable week in the history of aviation when a flight of 1 hour 12 minutes 6 seconds with a passenger and a speed test of 10 miles across country were made by Orville Wright in the government tests at Fort Myer was achieved with that biplane type of machine with which the brothers ushered in the era of practical aeroplane flight

GRANDEUR OF THE HUDSON FULTON NAVAL PARADE.

Of the many imposing pageants that will lend interest and dignity to the Hudson Fulton Celebration the most notable will be the great naval parade with which the week of festivities will open It is difficult to say whether this stately procession will be richer in historical or in contemporary interest. The presence in the van of that stately column of the 'Half Moon and the Clermont absolute replicas, as they are, of the quaint little sailing craft of Hudson and of Fulton's epoch making steamboat will in itself form an attraction that should prove sufficient to draw hundreds of thousands of patriotic lovers of their country's history to the shores of the Hudson River Yet without disparaging the rich historic interest of these two vessels it is certain that the spectacular we had almost said dramatic element of the naval parade will be furnished by the vast assemblage of modern warships which gathered from every naval country of importance in the world, will follow in the lead of the two vessels of 1609 and 1807

So successful have been the efforts to make the military features of the naval parade worthy of the occasion that it is now certain the fleet of warships will be the largest if we except the rendezvous of British ships in the English Channel that has ever been gathered together Including the foreign representatives there will be eighty war vessels, and of these, fifty three will fly the flag of the United States The dominant feature in the United States fleet will be the sixteen battleships which last year made the circuit of the world It is to be hoped that among the battleships will be the South Carolina and Michigan ' the first vessels of the Dreadnought' type to be built for the United States navy An effort should certainly be made to place these vessels at the head of the naval section The other battleships of the fleet will possess special interest from the fact that they will appear with the curious latticework or basket" masts, with which the ships of the North Atlantic squadron have now been equipped The fleet will come down from the rendezvous off Provincetown Cape Cod, where it is now engaged in the summer maneuvers and every ship will be in the very pink of condition and tuned up to the highest pitch of excellency in training and equipment. As the crowds look upon this stately line of battleships they will be able to more fully appreciate the enthusiasm which it awakened in the various ports throughout the world at which a call was made Following the battleships will be three of the latest armored cruisers vessels 500 feet in length and of 22 knots speed the three scout cruisers of the speed trials of which so much has lately been said and written the fastest of which are good for 25 and 26 knots maximum speed The torpedo-boat division will contain twelve torpedo boats and four submarines Associated with these will be the two cruisers Dixie and Castine whose duty it is to act as mother ships to the small craft The rest of the naval fleet will be made up of the tender Yankee , two supply ships, Celtic and Culgoa' the repair ship Panther fitted internally with forges and a complete machine shop besides seven colliers and a tug and torpedo vessel The total number of ships in the fleet, as given above is fifty three and it is possible that certain auxiliaries will be added before the final list is made up

Not only will this be the largest collection of war vessels ever assembled on this side of the Atlantic but it will be the largest fleet of an international character that has yet been gathered either here or in Europe England will be represented by four armored cruisers, the 'Drake," which it will be remembered was the flagship of the Atlantic squadron which visited this country a few years ago under Prince Louis of Battenberg the 'Duke of Edinburgh' and the Black Prince two of the latest of the pre-Dreadnought" armored cruisers and the "Argyll,' a smaller armored cruiser of earlier date This squadron will be under the command of Rear Admiral Hamilton The German government has notified the Department that it will send a squadron probably of four vessels under the command of the ranking officer of the German navy Admiral Von Kaister This squadron will probably include the four powerful and modern cruisers of the Scharnhorst' and Roon" classes and they will afford visitors to the celebration an opportunity to see some of the latest German cruisers prior to the introduction of the Dreadnought" type France will send a squadron of battleships under an admiral of the navy The flag of Italy will fly from the cruiser 'Etruria' and her cadet ship Aetna The Netherlands will send the cruiser Utrecht (a part of whose crew will man the Half Moon) and probably two or three other war vessels It is also expected that South America will be represented by five warships, and Japan although she will have no vessels in the parade will send a member of the Royal House, Prince Kunihiko of Kuni, to act as the official representative of that country

LEFFERT LEFFERTS BUCK.

The sudden death from apoplexy at his home in Hastings-on Hudson N Y on July 17th of Leffert Lefferts Buck has removed one more of the race of bridge engineers who by their work during the past few decades have made America famous as the country of long-span bridges. Mr Buck who was best known in this city as a former chief engineer of the Bridge Department New York, was born in Canton, New York, in 1837 His early schooling was received in the Canton Academy which he left before the completion of the course to serve an apprenticeship as a machinist. In 1859 he entered St Lawrence University, but at the outbreak of the war, two years later enlisted as a private in the 60th New York Volunteers. After serving through the war he was mustered out in 1865 with the rank of captain He then entered the Rensselaer Polytechnic Institute from which he graduated in 1868 The early years of his engineering practice included some notable work in Peru, where he was connected with the construction of the famous Verugas Viaduct on the Lima & Oroya Railroad In later years he replaced this bridge with a cantilever structure He also built a suspension bridge over the Santa River in northern Peru After his return to the United States in 1873 Mr Buck entered the Mechanical Department of the Illinois Central Railroad One of the works with which his name will always be honorably associated was the rebuilding of the International Suspension Bridge at Niagara Falls. First reinforcing the anchorages he gradually rebuilt the suspended structure and replaced the stone piers with steel towers the whole of the work being done without interruption of the traffic In 1881 he became resident engineer of the Central Railroad of New Jersey, and his work at this period includes the construction of a number of truss bridges of the Northern Pacific Railroad and large bridge across the Willamette River in Oregon Two of his finest structures are the steel arch which took the place of the old Clifton suspension bridge at Niagara and the steel arch railroad bridge across the river at the head of the Whirlpool Rapids. In 1895 he was made chief engineer of the Bridge Department, and became responsible for the construction of the Williamsburg Bridge, the longest suspension bridge in existence Mr Buck was a member and director of the American Society of Civil Engineers a member of the Loyal Legion of the Military Service Institute of the Burns Society, and of the Engineers' and Century clubs.

AN ANTIQUE ENCYCLOPEDIA

A quite recent record of the aggregate results of the investigation of papyri states that Berlin, through its fortunate acquisition of certain of these documents has come to share a cherished precedence A late number of the Sitzungs-Berichte of the Berlin Academy speaking especially of the papyri in Germany says First we had the Persians of Timotheos, then the Didymos commentaries on Demosthenes, together with many other fragments of Greek poetry and prose and to-day we have a very remarkable text indeed It is written on a leaf that formerly was wound around a mummy It was unrolled from the body without receiving the slightest injury Through the style of the letters used on it it is traced to the second century B C

In the text mention is made in formal order of legislators painters sculptors architects, and mechanics. Only the most prominent representatives of the professions and trades have been selected and frequently the particular achievement is stated to which the representative owes his fame Following these the seven wonders of the world the largest islands, the highest mountains the longest rivers and the most beautiful fountains are enumerated

The text which is concluded with these, is only an extract from a larger work which in its turn, is based on the results of Alexandrine investigation How fragmentary the transmission to us of these results formerly was is shown by the fact that not seldom we read mention of new texts and of new men. We are told for instance of a certain Phœnician, Abdaraxos who is said to have produced the objects of mechanical art found in Alexandria. and of one Dorion who invented an engine of war that bore the appropriate name The Ender of War

The greatest significance of the new find lies in the fact that it answers the question, what men in antiquity were known as classics in their art, with new and authentic information

◆

According to press dispatches, an inventor named Frank Russak has devised a machine for the benefit of that large public eager to hire a book for a few hours' reading without the trouble of going to a circulating library These machines are said to hold ten or twelve books, and display their titles so that they can be read without being removed from the case This case opens only when a certain coin is inserted in the slot as the price of hire Another coin is inserted in another slot as the price of the book, should the reader desire to keep it. The machines are to be distributed in hotels, trains, and seaside resorts, and wherever there is likely to be a demand for books to while away an hour or two.

ENGINEERING.

Some details have lately been made public of the interesting work on the Gunnison tunnel, recently completed by the government, which will bring some 200,000 acres of land under cultivation The tunnel from entrance to entrance is six miles in length The survey lines at the point of meeting differed 0 82 foot in level, 0 04 foot in alignment, and 0.86 foot in distance.

For two years past the Pittsburg & Lake Erie Railroad has been testing a car wheel that was designed by the chief engineer of the Carnegie Steel Company Although the Pittsburg & Lake Erie Railroad carries an unusually heavy freight traffic the wheel has stood up so well under the trying service that the company has announced that it will build a $3 000 000 plant at Homestead for the exclusive manufacture of the new wheel.

Rumor has it that another long step forward has been made in the art of armor plate manufacture It is stated that the new plate which is fabricated from a steel alloy combines great toughness with extreme hardness of face and that in a recent test a 6 inch plate stopped a 9-inch capped explosive shell We doubt it but if it was done the new armor must be even more superior to Krupp armor than Krupp armor is to that made under the old Harvey patents

During the month of June the total excavation on the Panama Canal was 2 895 798 cubic yards which is slightly less than the total for the month of May The mean rainfall was 11 85 inches for the month as compared with 9 82 inches in May There were 866 998 cubic yards of material placed in the Gatun Dam and 10 668 cubic yards of concrete were laid in the floor of the spillway

The advantage of having the White Star Line steamers call at Holyhead was shown on a recent trip of the Cedric when mails and passengers were landed at 1 30 P M and reached London at 7 15 P M Those passengers who went on to Liverpool were not disembarked until 10 P M being detained by the state of the tide in the Mersey The passengers who landed at Holyhead therefore reached London three hours before their fellow passengers were landed in Liverpool

So rapid has been the extension of block signaling on the lines of the Pennsylvania Railroad Company that they have established signal schools to train men specially for the signal service Apprentices serve a three years course The first year is spent in mechanical work with the construction gangs the second year in the office of the supervisor of signals and the third year will be devoted to outside work on electric and other signal appliances

Some idea of the scale of the Hudson Fulton river parade may be had from the fact that over 800 vessels big and little are expected to take part in it The Atlantic ports from New England to Norfolk have been drawn upon for reinforcements and it is stated that not a single licensed passenger steamer remains unchartered for the opening day September 25th

Another shocking submarine disaster has happened this time in the British navy The cruiser Bonaventure was conveying a flotilla of eight submarines when the cargo steamer Eddystone ran through the flotilla ramming the submarine C 11 and sending her to the bottom Of the sixteen men in the submarine thirteen were drowned A similar accident occurred a few years ago off Portsmouth England when a submarine was struck by an outbound liner which coming up from astern ran over the craft and sent it to the bottom

If Henry Hudson could have come back in the flesh last week and seen the Half Moon' or rather a modern version of it, lifted bodily from the deck of a steamer by a floating derrick and lowered into the water, he would have realised what great strides have been taken in marine architecture during the three centuries which have elapsed since his tragic death in the waters of Hudson Bay The Half Moon looked small even beside the navy yard tugs, and seafaring men, as they looked at the tiny craft, conceived a high respect for the courage of those early navigators in submitting themselves to the perils of long voyages over boisterous seas and along shores of which no chart existed.

Much has been said of late years about the ease with which a lock canal could be destroyed by the malicious use of dynamite or other high explosive Engineering News calls attention to the fact that an attempt made in 1900 to wreck the Welland Canal in this way produced surprisingly small results After two weeks' investigation, the two men concerned selected lock 24, and each lowered a satchel containing dynamite and a fuse to the water behind the gate at each end of the lock. Both charges were exploded; but the dynamite failed to carry away the gates. Although the explosions blew a hole about a foot in diameter through each gate and loosened the hinges, the gates remained in position, holding back the water.

ELECTRICITY

The United Railways and Electric Company of Baltimore celebrated on July 26th the fiftieth anniversary of the inauguration of its street railway service This company also started one of the earliest electric car lines in the country in 1885

Canadian doctors having reported frequent cases of slight injury or strain to passengers alighting from electric cars the Toronto Railway Company at the request of the Railway and Municipal Board has made some experiments with both two and three steps below the car platform level The latter were found to project too far from the side of the car but the two-step pattern has been adopted

An electric rail grinder has been devised by the Albany & Hudson Railway for use in grinding the wing rails of frogs to insure smoother passage of car wheels A motor is carried on an ordinary hand car a sort of small barrow carrying the emery wheel being suspended from a crane overhanging the end of the car and the operator supplying the necessary pressure upon the grinding wheel through the handles of the barrow

A new use for the oscillograph is described by Mr K Simons in the Elektrotechnische Zeitschrift In the investigation of the oscillations which occur when switching off a continuous current in an inductionless circuit A record is obtained photographically showing most clearly simultaneous variations of different amplitudes It is suggested that a valuable application of the oscillograph to wireless telegraphy may be made in this way

An additional advantage claimed for electric welding of rails is the reduction of corrugation of the surface by traffic and resultant noisy riding of the cars Electric railways in Berlin Hamburg and Bremen claim that the welding of a strip of soft iron to the rail surface not only prevents the corrugation but actually reduces the noise due to corrugations already made but the experiment is not old enough to prove whether the relief is permanent

A curious accident occurred at the No 3 power house of the Niagara Falls Hydraulic Power and Manufacturing Company on Sunday afternoon July 25th by which two employees were injured The casing of one of the new 10 000-horse-power turbines burst and a large piece of casting was thrown across the station which was partly flooded by the outrush of water The turbine was under the normal head of about 165 feet of water but had been tested to a much higher pressure

The 'boosters" of the town of Montgomery Ala have erected a monster electrically illuminated sign bearing the name of their community on the roof of a factory facing the railroad The sign is 75 feet high and 85 feet long lit by 2 600 lamps and bears an immense key and the inscription Montgomery Your Opportunity with a sky rocket effect The idea is to impress the name on thousands of passengers going by on the railroad and possibly ignorant even of the name of the town

The advantages of lifting magnets for the handling of all kinds of loose material—piles of turnings and other scrap castings of awkward shape and rails etc requiring to be compactly bound in order to be handled by a crane—have won rapidly increasing recognition of late Lifting magnets are in use at the immense new plant of the United States Steel Corporation at Gary Ind capable of lifting the entire top layer of a pile of 60 foot rails lock section (alternate rails inverted so as to hang together) with an aggregate weight of 15 tons

The use of transformers as choking coils is suggested by Mr J D Coates in a paper read before the Institution of Electrical Engineers (Brit) He excites the core with direct current in addition to the alternating current and employs to prevent alternating current being induced in the direct-current circuit a second transformer inducing an E M F in the direct-current circuit equal and opposite to that induced by the first transformer Choking coils so made are used for the testing of single phase and polyphase alternators

Some interesting experiments are being conducted by the South Park commissioners of Chicago in the lighting of the boulevards under their control Several different types of lamps have been installed on temporary posts in order to observe the comparative illuminating effect and determine how high the lamps should be hung and how far apart and similar considerations The lamps under test or about to be tested include incandescent gas lamps inclosed arcs, magnetite arcs flaming arcs and incandescent tungsten lamps The commissioners hope to obtain valuable data, both as regards illumination and economy from these trials the latter being an important factor as it is estimated that 1,000 000 kilowatt hours per annum will be required for the lighting of Grant Park alone The tests are under the supervision of Mr J. A, Radford, consulting engineer to the commission.

SCIENCE.

Prof. William G Anderson, director of the Yale gymnasium is carrying on a series of experiments on the heart action of athletes More than 600 experiments have been made for the object of determining which sports exert the most harmful effect upon the heart Moreover the effect of oxygen on the heart during exertion is also being carefully studied A report is promised in October

The French parliament has passed a law which provides that in transactions relative to diamonds pearls and precious stones the metric carat may be employed to designate a weight of 200 milligrammes (3 086 grains troy) and prohibits the use of the word carat to designate any other weight As many other governments are ready to enter into the reform and unification of the carat and have only been awaiting the initiative of France it is reasonably certain that the metric carat of 200 milligrammes will within a few months be the only carat recognized by law in the majority of countries interested in the trade in gems

Doelter has published the results of experiments on the action of radium rays on the colors of precious stones and those of dyed fabrics in atmospheres of oxygen and of nitrogen The effect of hydrogen dioxide ultra violet rays and elevation of temperature on the color changes caused by radium was also studied In these changes neither organic colors nor the rare earths played any considerable part the oxides of iron chromium and manganese being in all probability the principal factors The hypothesis that the colors like those of rock salt are due to traces of colloidal metals which are ionized by the radium rays appears worthy of consideration Most mineral dyes however appear to be unstable even the sub oxides

Modern military exercises are designed with a view of increasing the efficiency of the individual soldier The same idea is carried out in the equipment Gaudy uniforms have been replaced by dull and almost invisible tints of gray and khaki and the weight of the gun and kit has been reduced for the sake of mobility and increased ammunition-carrying capacity The art of utilizing natural cover and of maneuvering under cover is taught by long and varied practice In the execution of these maneuvers crawling or creeping is usually necessary To facilitate this movement Gustav Mueller of Stuttgart has invented and patented a device consisting of wheels rollers or runners attached to a frame or to tent poles knapsacks or other suitable parts of the equipment The utility of this invention remains to be proved by practical experience but there can be no question of its novelty and originality

A discovery of great interest has been made not long since at Pompeii where the excavation work is being steadily carried on Under the ash deposits there was found an extensive villa of a handsome construction and ornamented with very fine frescoes The villa contains statues and other works of sculpture both Greek and Roman besides very rich furniture which is well ornamented and also many vases of different kinds There were also found coffers filled with gold and silver money In the basement are great amphoræ which were used for storage purposes and in the triclinium the tables were prepared for a banquet of thirty persons An abundance of silverware is one of the features of the discovery and it is said to be equal in weight and artistic character to the silverware discovered in the villa of Boscoreale and now possessed by the Louvre Some of the silver pieces seem to have been taken out at a previous epoch for there are traces of clandestine search which was made at a former date

Neuberg has recently completed a comprehensive study of the changes produced in organic compounds by light These compounds in great variety were employed in the form of 5 per cent aqueous solutions containing small quantities of uranium salts which act as catalyzers probably by absorbing the luminous rays and conveying their energy in another form to the surrounding medium All of the solutions employed remained unaltered so long as they were kept in the dark but exposure to light produced a great variety of changes in color and odor and caused the formation of new chemical compounds often within a few minutes Alcohols were converted into aldehydes and acids were transformed into aldehydes or acetones containing an equal or smaller number of atoms of carbon Cane sugar and other disaccharides were inverted Glucosides were hydrolyzed or separated with absorption of water into the glucoses and the acid characteristic of each glucoside Glycerides or fats and oils were partially saponified albuminoids were partially hydrolyzed In general chemically inert substances are converted by light into chemically active compounds such as aldehydes and acetones This fact may account for the therapeutic value of light baths in certain diseases

ORVILLE WRIGHT'S RECORD FLIGHTS AT FORT MYER.

On Saturday, July 24th Orville Wright, in continuing his practice flights for the performance of the Government contract made a flight of 20½ minutes. He made this flight preparatory to taking Lieut. Lahm as a passenger, but unfortunately when descending the aeroplane was caught by a sharp air current and twisted slightly so that when it struck the ground one of the skids was broken During this practice flight Mr Wright described very small circles and performed various difficult maneuvers in order that a cinematograph operator could take photographs. The flight began at 6 56 P M and was terminated at 7 16 30 There was a light breeze of about 6 miles an hour and the aeroplane bobbed up and down considerably It also tipped at an alarming angle when making the short turns

On July 26th Orville Wright started the machine successfully without the aid of the falling weight The machine was placed upon the rail and held in position It gathered headway quickly as soon as it was released but after running off the rail it skimmed along through the grass a considerable distance before it finally rose in the air The start was made against a wind of some 15 to 18 miles an hour velocity On the first round the machine did not rise more than 25 feet, but during the remaining two and one-half circuits of the parade ground it went up to three or four times this height and the descent made in several long swoops, was quite thrilling The flight was made specially for President Taft, who for the first time visited Fort Myer for the purpose of seeing an aeroplane fly The War Department had announced that the endurance test would be made, and a crowd estimated at 10,000 people was present, but on account of the wind Orville Wright thought it best not to make the test, so he made the brief exhibition flight instead The flight was also notable for the fact that it is the first time the Wrights have publicly demonstrated in their native land that their machine can rise from the starting rail under its own power, and also that it is capable of flying in a strong wind

July 27th was the record breaking day as far as the endurance flight with a passenger was concerned At 6 36 40 P M Orville Wright and Lieut Lahm started on what turned out to be the longest flight yet made by an aeroplane carrying two men To fulfill the government contract, an hour's flight with two men was required There was no breeze of any account blowing at the time the flight began, though during the course of it a breeze sprang up which at times caused the machine to bob up and down considerably There had been a high wind all the afternoon, and just at its close there was a slight shower Subsequent to this the wind died down and it was decided to attempt a flight. As soon as the machine had been started by the falling weight, Orville Wright drove it to a good height and circled seventy-five times around the parade ground which is about 4,000 feet in circumference. Some of these circuits were smaller than others but their average was probably such that the machine traveled in all in the neighborhood of 50 miles at an average height of 75 feet At the close of the seventieth round which completed the hour in the air, there was great applause, waving of hats and handkerchiefs, and tooting of automobile horns Also when Wilbur Wright's record of 1 hour, 9 minutes, and 45 seconds was broken, the latter ran out and cheered for his brother Soon after this the machine gradually sank to a lower altitude, and finally alighted easily at the end of the seventy fifth round. Orville Wright's previous best record with a passenger was 9 minutes and 6 seconds on September 12th, 1908, when he traveled about 5 88 miles with Major Squier as passenger He had also made a 6-minute flight with Lieut. Lahm as passenger last September It is therefore quite remarkable that he was able to soar aloft with Lieut. Lahm for the first time this year on a machine which is somewhat smaller than that used before, and to remain in the air nearly an hour and a quarter without mishap The time of the flight was 1 hour, 12 minutes, and 36 seconds. The next day he hoped to complete the cross-country speed test to Alexandria, Va., and back, a distance of 5 miles each way, but owing to a strong wind and afterward to a balky motor, due, it seems, to a stoppage in the gasoline feed pipe, no flight was attempted Nor was it possible to make a flight on July 29th, for after the wind had died out at Fort Myer, and when he was about to start, word was received from Alexandria that a very strong wind was blowing, and so it was not thought best to attempt the flight.

Late in the afternoon of Friday, July 30th, Orville Wright accomplished a flight such as had never been made before by any aviator—a flight which gives without question to him and his brother the title of premier aviators of the world This was the 10-mile speed test across rough, wooded, and broken country to Alexandria, Va., and back The flight was made with a strong westerly wind blowing across the course. The wind carried the machine out of the direct line which

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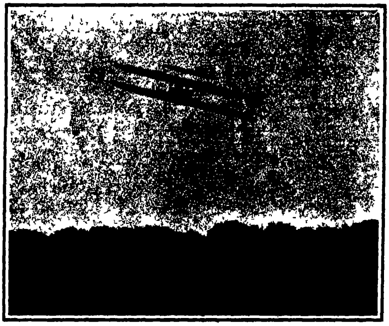

ORVILLE WRIGHT AND LIEUT LAHM FLYING IN THE GOVERNMENT ENDURANCE TEST AT FORT MYER, VA., ON JULY 27TH.

THE FIRST SUCCESSFUL CROSS-CHANNEL FLIGHT.

Six days after the first attempt at flying across the English Channel was made by Hubert Latham, M. Louis Bleriot, who had brought his "No XI." monoplane from Paris to Calais especially for the purpose, made a successful flight and landed on the English shore. The "Antoinette IV" monoplane used by Latham was so badly damaged when being pulled aboard the torpedo-boat destroyer and transported to the shore, that a complete new machine—"Antoinette VII"—was brought on from Paris and was in readiness whenever this aviator should make a second attempt. On Sunday, July 25th, M. Bleriot arose at 3 A. M. As the weather conditions seemed favorable, he examined his machine, started the motor, and, shortly after 4 A. M., made a fifteen-minute trial flight, circling for 9½ miles around Calais and its environs and landing upon the cliff from which he was to start. Everything worked perfectly and consequently, as soon as the sun had risen, he immediately climbed into his seat, had the motor started, and, speeding it to the limit, shot up over the telegraph wires and started off over the strait, heading directly for the English shore. The start occurred at 4 35 A. M. The air was clear and a southwest breeze was blowing. The torpedo-boat destroyer "Escopette" was several miles out in the Channel, headed for England also. As soon as the captain saw Bleriot coming, he put on full speed, but was soon overtaken and passed by the fast-flying mechanical bird Ten minutes after leaving the French coast the monoplane was out of sight. After passing the torpedo boat, Bleriot flew for ten minutes without steering to right or left. There was nothing to go by and flying at a forty-mile clip without compass or any other guide must indeed have been a thrilling sensation After about ten minutes of such flight the English shore came into the view of the intrepid aviator He recognized that the strong southwest wind of about twenty miles an hour velocity had carried him to the eastward He was heading toward Deal As soon as he found this out, he turned to the left, heading directly into the wind, and following the coast for two or three miles until, when within a mile or two of Dover, he turned into an opening between the cliffs. A strong wind caught him and swung him completely around, but he managed to make an abrupt descent upon suitable ground between the cliffs, where a fellow countryman was awaiting him and holding aloft the French flag The running gear and propeller were damaged, but the aviator landed without hurt, although he dropped quite suddenly from a height of 65 feet. The news had been flashed to England that Bleriot was making the crossing and there were a considerable number of people on hand to witness him make the descent. He was given a great ovation and was taken by his friends to the hotel immediately Mme Bleriot arrived on the destroyer soon after and added her congratulations when met by her husband at the pier.

M Latham overslept and was only awakened just after Bleriot had left France. He attempted to follow with his Antoinette monoplane, but the strong wind that sprang up soon after caused him to change his mind. He wired congratulations and said he hoped to follow soon.

Two days later he made a second attempt in the afternoon, and this time he succeeded in traveling to within two miles of the English shore.

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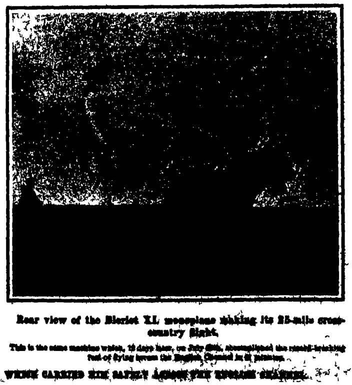
The No XI monoplane and M. Louis Bleriot, engineer, its designer, builder, and pilot.

The machine is shown in its ¾-hour cross-country flight of July 13th It covered 25 miles with one intentional stop at an average speed of [illegible] miles an hour.



Rear view of the Bleriot XI. monoplane making its 25-mile cross-country flight.

This is the same machine which, 12 days later, on July 25th, accomplished the record-breaking feat of flying across the English Channel in [illegible] minutes.

LOUIS BLERIOT AND HIS FAMOUS NO. XI. MONOPLANE WHICH CARRIED HIM SAFELY ACROSS THE ENGLISH CHANNEL.

ELECTRIC LAMPS IN THE MAKING.

BY [illegible] BLOUNT WARNER

Very few persons out of the great number who are familiar with the many uses to which electricity may be put know how the bulbs are made. In the Philadelphia plant here illustrated and described, 7,000 lamps are turned out daily, and each lamp must be handled sixty-four times. Sixty four handlings seem an incredible number for so small an article. Many of the handlings are relatively unimportant to the lay man, and will be eliminated from this article.

First of all, no lamp manufacturer makes his own bulbs, since only about one-half or six-tenths of the glass product of a factory is of the requisite standard for bulb making. Fortunes have been spent to bring the lead glass standard up to this requirement.

The bulb is first blown into a divided iron mold. When the "dip" or mass of nearly molten glass has been twirled a moment at the end of a tube, the operative inserts it into the mold, and gives the tube a puff of air until the glass bubble on the end fills out to the limit of the mold. An assistant reaches over and cuts the tube away from the now hardening bulb, the iron mold is divided, and the hardened glass bulb is thrown out. Its shape is about like that of a young leek or onion—much enlarged—and with the sprouts or stem nearly all cut away.

In all there are three glass parts that enter into the manufacture of a lamp. These are the bulb itself, the stem and a top tubing through which the air in the bulb is extracted. When the air has been removed and the bulb sealed, this tubing is cut off with a jet of flame and thrown away. The parts are all made by the same formula; otherwise, when heated, they would not join together. Filaments of the type in general use are made from ordinary absorbent cotton, reduced by a chloride process to a thick liquid state. By this process the silicon in the cotton is removed, leaving a residue of cellulose, which is treated for carbonization. Under air pressure this liquid is squirted through a glass die, emerging in the form of thread or string. After this fiber has been passed through a number of hardening chemical baths, it is wound on spools for drying. When thoroughly dried, it is about as strong as [illegible] string and is cut in desired lengths, [illegible] from 2½ to 7 mils. A mil is a unit used almost exclusively in electric wire measurement.

Treating machines for carbonization and equalization of filaments.

Pasting and straightening tables—straightening in the foreground.

The "tubulating" machines melt a hole in the top of the bulb and attach a small glass tube thereon.

Sealing the stems into the bulbs.

Placing the threaded brass collars on the necks of the bulbs.

ELECTRIC LAMPS IN THE MAKING

The next step is to form the thread in the shape desired, there being several different-shaped carbons on the market. The one in general use is known as the oval-anchored filament. Formerly a pure black carbon was used on which to form and carbonize thread, but the more recent method is to use a compressed low temperature and then, after forming, to carbonize the thread. Carbonization requires high temperature, and when the thread comes out of the oven it is pure carbon, possessing a higher resistance than any other known carbon.

From the baking oven the carbons come out jet black and about two-thirds of their original length. On account of their shrinkage and uneven air pressure when being forced through the die—and from a liquid to a stringy state—the carbons are rarely if ever, of equal diameter throughout their length. These weak spots are corrected by a process known as flashing or treating, the object of which is to make the carbons of uniform diameter and resistance throughout their length. It is not merely a question of filling up the cavities, as the provision of a uniform resistance in the carbon is of equal importance.

Carbons are treated in glass jars or vessels, electrically connected through the cover of the jars, through which a vacuum is drawn. When the vacuum has been produced, an electric current is turned through the carbons under test for the purpose of heating them. The temperature of the carbon is gradually increased until a pure carbon has been formed by the electrical vaporization of gas, derived from gasoline injected into the vessel. At this moment, when the filament under test is burning at a high temperature, the smallest parts of the filament are naturally glowing with the greatest heat. This attracts the newly introduced carbon, which deposits itself in the parts of the filament possessing the greatest temperature. In this manner the cavities are filled out and the filament brought to an equal diameter throughout its length. When the filament under treatment shows the desired resistance, the current and gas flowing into the vessel are automatically cut off. After each filament has been tested and inspected it is passed on to the mounting department, where it meets a glass tube blown as a stem. This tube is flanged at one end and flattened at the other with a piece of platinum extending through the flattened end. To this platinum are joined two copper outleading wires. Platinum wire is the best material to which a filament can be attached, since it has a greater power of heat resistance than any other known metal. But platinum is very expensive; its cost is seldom less than $27 an ounce and it sometimes advances as high as $42.

The carbonized filament is next attached to the platinum ends of the wire and then the stem with its wires and filaments is ready for insertion and sealing into the bulb. But before this sealing operation the stems and their filaments are again 'flashed' as a final test.

After the bulbs have been unpacked on their arrival at the lamp factory, they are washed internally with cold filtered water to remove the bluish cast which from a cause unknown to lamp makers comes in bulbs and must be eliminated before an undimmed light can be procured.

When the bulbs have been dried they are brought in racks of fifty to the tubulating machine, which first, by means of an air-driven jet of flame melts a hole in the top of the bulb and, when this bulb has been set in another mechanical socket, drops a small tube through a magazine channel on the spot in the glass that was melted through. This tube and

(*Concluded on page 100*)

A NOVEL TYPE OF ROTARY CONVEYER.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Various methods have been devised for the mechanical transportation of the top-soil or callow overlying iron from the excavating site to the dump. A belt or a tray conveyer is ordinarily employed Unfortunately the belt conveyer, while efficient, is somewhat expensive to install and its maintenance is costly while the tray conveyer lacks sufficient capacity

In order to overcome these deficiencies a novel type of transporter has been devised by an English engineer Mr A R Grossmith, of Kettering Northampton He has evolved a rotary type of conveyer, the general principles of which may be gathered from a reference to the front page illustrations.

Prior to the adoption of this system the method was to drive a cutting through the ore bed, along which cutting railroad tracks were laid, so as to enable the ore to be dumped straight into the cars. The greatest difficulty experienced however, was in the removal of the callow which was invariably taken out by hand from one side of the cut, and transported by wheelbarrows running over temporarily laid planks to the opposite side where the dump was formed The adoption of large steam excavators, however called for a more expeditious means of dealing with the spoil and as the conveyer did not meet the situation to the best and most economical advantage the rotary system was invented

As may be seen the transporter itself comprises a huge wheel 80 feet in diameter, built on the principle of a bicycle wheel The rim is so designed as to offer a flat table on the horizontal face which measures 3 feet 6 inches in width and which is made up of ¼ inch steel plates The vertical support on the inner side is also built up of ⅛-inch plate 2 feet in depth with a diagonal strut extending from the lower end of the outer face of the vertical member to the outer under edge of the horizontal table at frequent intervals around the periphery of the wheel, to insure the rigidity and strenght of the structure In the center of the wheel is a light steelwork hub to which the rim is supported by 224 (112 top and 112 bottom) ⅝ inch steel wire radiating tension spokes disposed tangentially in precisely the same manner as in the ordinary bicycle wheel, those spokes being kept taut by means of eye bolts at the rim

The lower extremity of the hub is carried on roller bearings The mounting and balancing are such that the unloaded wheel despite its weight and size, can be turned round by hand without effort. The wheel is mounted upon a substantial pedestal carrying the driving mechanism, which in turn is carried on a heavy wheeled trolley, so that the whole machine can travel up and down the cut in either direction as desired, upon an ordinary track Moreover, the wheel can be rotated in either direction according to the forward or backward traveling motion of the machine

Probably the two most important features of the plant are the loading and discharging facilities respectively On the banks where the steam excavator works is a special form of mechanical hopper This is circular in form and consists of four essential parts A central annular disk built up of mild steel plate ⅝ inch thick by 8 feet in diameter, forms the bottom This is revolved by means of under bevel gearing Around its outer periphery is fixed a vertical stationary steel guard 2 feet in height by ⅛ inch thick completely inclosing the revolving section, except at that point opposite the annular table of the conveyer wheel which is the discharge opening. There is another annular shield or ring 3 feet 6 inches in diameter disposed around the boss of the central hopper mounting This ring is only 4 inches in height and is used to take the end thrust of the scraper by means of which the material is shot on to the rotating transporter wheel This scraper or plow has its outer extremity securely held by one end of the outer vertical wall of the hopper, and stretches diagonally across the revolving base plate so that its opposite end bears against the inner thrust ring. The plow is 6 inches in height. The hopper is mechanically driven from the mechanism of the transporter wheel so that when the latter is stopped the revolution of the hopper is also brought to rest

When the steam excavator bucket deposits its charge into the hopper the material is swung round by the revolving base until it comes into contact with the diagonal plow, which deflects the stream of ballast on to the transporter wheel through the opening in the outer vertical wall of the hopper Should a greater mass of material collect at this opening than the conveyer wheel can successfully handle, because the deflecting plow is only 6 inches in height it rides over the latter, is carried round again in the hopper and is then shot out Thus the hopper can maintain a steady, uniform feed onto the rotating conveyer wheel Indeed, the uniformity of this discharge constitutes one of the most important features of the invention and is directly attributable to the design of the hopper, since its discharge can be adapted to the capacity of the conveyer to a nicety By dumping the excavated material first into the hopper instead of straight on to the wheel, there is no disturbance of the load as the shock of the shovel dump is absorbed by the hopper and is not felt by the wheel owing to its flexibility and the fact that the rim is not connected at that end of the cantilever Nor can any blocking ensue, such as, for instance, is often the case with the ordinary type of hopper, especially when dealing with wet clay

Another equally important feature is the means of discharging the material from the revolving conveyer wheel at the desired spot. This comprises a small plow which can be easily and readily moved and placed in position at any point of the annular table, even to a point well beyond the diametrical position of the hopper or in excess of 180 degrees. The plow is mounted upon a carriage and stretches diagonally right across the width of the rim table The top edge of the wheel rim is surmounted by a T bar and there are a series of roller carriages arranged to run on it and to which the plow and a ⅝ inch wire control cord are attached. The inner point of the plow holds itself in position against this bar and cannot possibly move. An angle frame serves to keep the plow face rigid and at the angle a horizontal wheel runs on the T-bar, being kept there by the pressure of the ballast, and also serves to take the back thrust against the outer point of the plow In order to prevent drag and to reduce friction the plow carriage is mounted on small wheels which engage with the surface of the revolving annular table of the conveyer The control cord is supported by carriages mounted on hardened rollers engaging with the T bar and may be varied in number as desired, but which insure the cord passing in a series of short tangents to the driving station. From this point either by paying out or winding in the cord the position of the plow can be set wherever desired, while the conveyer wheel is in operation The conveyer in its revolution carries round with it the earth it has received from the charging hopper until it comes into contact with this scraper which deflects the material off the table on to the spoil dump, and the simple means of varying the position of the discharging plow enables the spoil to be distributed evenly over a wide area. This is a most important consideration in many places, such as at Corby since afterward the spoil dumps are reclaimed for agricultural purposes, which is an easy matter when the waste has been evenly distributed in such a manner as is possible by this means The method of mounting the plow and the easy angle at which it is set serve to render it very efficient in its work, and the wear and tear upon the revolving table is practically *nil*. In fact, in one instance after the conveyer had been at work for six months continuously handling from 400 to 500 cubic yards of sandy material per day it was found that all the bloom had not been removed from the plates of which the table is built.

The large conveyer wheel is driven by a 1½ inch cotton rope which runs in a groove provided at the lower end of the vertical member of the rim table to which the spokes are attached Owing to the absence of intricate mechanism, chains, rollers, idlers, and so forth the power required to drive the installation is very small The wheel, including the hub and platform, weighing 7 tons, is carried upon a horizontal cantilever arm which in turn is carried in trunnions. By means of these latter the arm, together with the wheel, can be raised and lowered to any desired level either to suit the excavator shovel or to permit railroad trains to pass beneath to and from the mines. The heavy pedestal frame upon which the whole is mounted is fitted with a turntable, a very convenient arrangement which permits the plant to enter narrow cuttings standing obliquely thereto, independent of the direction of travel As the whole plant runs upon a three-wheel track it can be easily made to follow sideways in the track of the excavator as it eats its way into the hill, as well as follow it up and down the length of the cut. A small boiler and steam engine housed on the turntable provide the whole of the power for driving the hopper and wheel as well as propelling the conveyer along its track.

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Simulated Disease Revealed by Electricity.

Some cases of apparent local paralysis are feigned or simulated. For example, long after a broken arm is healed, the patient may assert that he is unable to use the arm properly It is then the duty of the physician to find whether a real paralysis exists, and where. Electrical energy may be compared to psychical energy, the battery to the brain, the wire to the nerve, and the electric bell, for example, to the member moved. A muscle contracts when a faradic current is applied to the corresponding nerve. If the muscle on the affected side of the body reacts as strongly as the corresponding muscle on the opposite side the partial paralysis is simulated. If the muscle on the wounded side reacts less strongly than its fellow there is a real disease of the nerve. Finally, if the muscle on the wounded side reacts more strongly than its fellow the seat of the paralysis [illegible] central nervous system, the brain or the spinal cord.

Dr. Larat has devised an instrument which makes a graphical report of the muscular contraction. The curves thus obtained form important pieces of evidence in suits of damage for accident.

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The Marblehead Race for Motor Boats.

The fifth Marblehead race, which has now become an annual function and bids fair to become considered the accepted Derby of the motor boat, took place on Saturday and Sunday, July 17th and 18th. There were twelve starters and only two failed to finish, one of which was unfortunately burned and sunk.

A start was made at 10 30 A. M. on the 17th from the pier of the Crescent Athletic Club at Bay Ridge in New York bay in perfect weather which continued throughout the run, being even calmer on Sunday and interrupted only by a slight squall that afternoon.

The "Kitcinque," built specially for the race and launched only four days before, was the largest and much the most powerful boat entered, having a 75-horse-power Sterling motor, while the "Josephine," which finished first, though an inch longer, has 4 inches less beam and only one-third of the power, being equipped with a 25-horse-power Jäger engine. The former was expected to beat all records for the course and bade fair to do so, being out of sight ahead of the second and third boats when they were hull down ahead of the rest of the fleet, and it was most unfortunate that she should have been so tragically lost, keen sympathy being felt for her owner and crew, who were fortunately rescued unhurt. The "Kitcinque" was off the Sow and Pigs lightship in Vineyard Sound when a stoppage of the gasoline pipe caused the engine to back-fire through the carbureter, setting fire to oil in the bilge. Efforts to smother the flame were fruitless, and the crew were compelled to abandon their vessel, some taking to the water and others to the small dinghy carried, which would only hold three, only just in time before the gasoline tank exploded. The "Josephine" was therefore the first boat to cross the line at Marblehead six hours after the burnt boat had been expected, at 6 36 P M. on Sunday, her official time for the 285 miles run being 32 h 1 m 45 s. The second to arrive was the "Nimrod," the smallest boat entered, only 30 feet 2 inches long, with a 15-horse-power Atlantic engine, which received quite an ovation and has been highly commended, and would have been higher on the official list had she not lost an hour in putting in at Cottage City to replenish her gasoline supply The "Elmo II," which finished seventh, was the official winner on time allowance, the latter being figured on a complicated proportion of engine power to measurement, she is 34 feet 2 inches long, 8 feet 9 inches beam, and has an 18-horse-power Standard motor, and her corrected time was 25 h. 24 m 55 s. out of an elapsed time of 36 h 32 m 25 s.

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The Current Supplement.

Perhaps the most distinguished physicist of our time is Prof Svante Arrhenius. A splendid portrait of Arrhenius appears on the front page of the current SUPPLEMENT, No 1758, and mention is made of his remarkable scientific work. Mr Rufus P Williams writes on an ancient duodecimal system. How a garden seat can be made is told by Mr A. C. Horth. M Kennett tells how electromagnets may be calculated It is a well recognized fact that our present railway systems are very inadequate to the demands of modern traffic. Many railway men have studied the question of reform without finding a satisfactory solution The latest proposition is that of the well-known Berlin publisher, August Scherl. Mr Scherl's plan is fully described and illustrated in the current SUPPLEMENT Lieut. John C Soley writes on the Messina earthquake and the events preceding it. Everyone remembers the old-fashioned glass globe in which a few gold-fishes led a wretched existence. In its place we now use the aquarium, which is adapted to the conditions of piscine life, and which is an adornment to any room. Some ornamental fishes that can be kept in such an aquarium are enumerated and described by Berthold Koerting. Maria Parloa tells how fruit can be canned and preserved. Zeolites are a comparatively small group of silicates distinguished by the fact that they contain water as an essential constituent. That they play an important part in the economy of plants is pointed out by Prof. O. N. Witt.

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A consular report dealing with the trade and commerce of Mozambique (Portugal), states that a light railway running from Matamba, in the Bay of Inhambane, to Inharrime, 50 miles to the southwest of that point, has been under contemplation for some few years past. This scheme, for which it is understood orders have now been placed for the rails and sleepers, is intended to develop the rich northern districts of Gaza, which are regarded as among the most valuable in the province. No work has yet been commenced, however, possibly because of [illegible]

Correspondence.

THE NUMBER OF OUR ANCESTORS.

To the Editor of the Scientific American

My only excuse for asking you to give more space of your valuable paper to this question is that there still seems to exist a doubt as to the location of the fallacy in the proposition that *n* generations ago we each had 2^n ancestors, for, as Mr Venning states, history probably justifies the conclusion that such a fallacy exists. As Mr Hakin and Mr Constable have shown, Mr. McCullough's contribution furnishes no solution to the problem. However, it contains a hint. Mr. Venning's calculation of the number of A's ancestors is based upon the assumption that the two members of every marriage among his progenitors have been totally unrelated However, had some of these couples certain ancestors in common, a reduction in the number of A's ancestors would result. And looking from Mr. McCullough's point of view, which shows well the large number of descendants ordinarily following in several generations from one couple, we can easily imagine that the marriage of distant relatives occurs with unsuspected frequency

Ithaca, N Y ROBERT KING

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HOW DOES A BIRD SOAR?

To the Editor of the Scientific American

In regard to the question "How does a bird soar?" the writer has a theory which he has never seen in print.

Some writers claim that a soaring bird utilizes an ascending current of air which has been caused by some obstruction on the earth's surface in order to maintain a practically horizontal line of flight. The writer believes a bird creates (by the displacement of its body) a strong swell or upward pressure of air which does materially assist it in soaring flight.

Boatmen know that a swell is created off each side of a swift moving boat. A certain distance back of this swell is a trough, and following a trough a breaker appears. A full round bow will drive this swell nearly at right angles from the direction the boat is moving, a very sharp bow will send this swell away aft. These swells are all created by the displacement at the bow of the craft, and the direction of the swell will be governed by the shape of the bow and the speed of the boat. Water being a solid medium, a sudden displacement will cause a bulge in the water near the displacement, for it must follow the lines of least resistance, which in this case must be upward and outward

A bird flying through the air must displace an area of air equal to its body Air being an extremely elastic medium, an object like a bird's body (with a full breast and a hollow or concave surface in the body under the wing) passing through it will tend to compress the air and drive a large portion of it outwardly and upwardly practically at right angles to the line of flight. This compressed air will instantly expand largely in the direction in which it was driven by the displacement. The upward and outward expansion of this current will create practically the same swell in the air as the boat created on the surface of the water Or there will be a high-pressure area under the wing seeking to expand in every direction If the air above the wing is neutral and the air under the wing is compressed, say, two volumes in one, the expanding force upward will be 7 pounds to the inch. If the concave surface of the wing fits the curvature of the swell, and the bird advances its wing well toward the front of this swell, the wing will have a pitch of at least 10 deg. downward with the horizon With a slight contraction of the muscles (invisible to the eye) driving the wing backward against this air swell, the bird will be capable of keeping up a speed sufficient to cause the angle or line of expansion to follow lengthwise of the wing.

When muscular contraction can no longer keep up the necessary speed, the wing will drop backward to the top of the swell, or the swell will outrun the wing, the bird will then be compelled to flap his wings a few times, they will act as propellers to gain momentum or speed, until the wing can again take its place at the front of the swell or expanding air

A careful examination of all heavy soaring birds shows them to be full-breasted (note the pelican for instance), while all our swift, flapping-wing birds, such as pigeons, have very sharp lines. The soaring birds with their full, blunt breasts drive large swells nearly at right angles to the line of flight, while the fine, narrow-breasted birds drive their swells far backward, leaving their wings to perform their action on undisturbed air.

There is yet another point to be taken into consideration: the rear edge of all birds' wings is very thin and flexible. The diameter of the compressed body of air will be possibly two-thirds the width of [illegible] near the bird's body. It is believed that the [illegible] [illegible] under the front edge of the wing is where the bird gets its muscular push on the air swell, tending to drive the swell backward As the air cannot expand upward through the solid concave part of the wing, it is driven backward by the new forming swell toward the rear edge of the wing. Here the flexible tips of the feathers give way to the expanding air and turn upward. This tends to drive the wing forward through the spring of the feathers as the air escapes upward at the rear

It is hoped that some of our aeronautical friends who have the necessary apparatus will experiment along the above lines and give the results of their findings to the ever anxious inventors as this may, in the end, result in a practical flying machine

W Palm Beach, Fla. C N NEWCOMB.

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ELECTROCHEMICAL AMALGAMATION

To the Editor of the Scientific American

In recent years it has been discovered that there are large areas in southern California, Nevada, Arizona, New and Old Mexico which contain vast deposits of low-grade sands containing gold values averaging from $1 50 to $7 50 per ton Many of these deposits are of unknown depth. The values are microscopic and there is no method at present known to the miner by which the values can be profitably extracted There are also immense ledges and even mountains of low grade ore, very refractory, which cannot now be profitably mined. The sea beaches from the Isthmus to the Arctic contain vast deposits of gold bearing sands, but no practical method is known of recovering the gold, which is fine and flakey, and which cannot be saved by the usual gravity devices. In addition to these unworked gold fields, there are in California many miles of river beds containing debris and tailings from the placer mines, these tailings contain gold to the amount of $1 per ton, this amount being a low average, and the tonnage is beyond computation The values are too elusive for extraction by any of the standard processes of gold saving

In Alaska there are hundreds of miles of beach and river deposits containing vast sums of gold which is beyond the reach of the miner In the sands of the Nome beaches the miners probably left $100 000 000 in gold because the riffles would not hold the fine beach gold, and they knew of no way to save the microscopic values which are associated with the particles of black sand

There is enough gold in these various deposits to furnish ample coinage for all nations for a century and it may interest the readers of the Scientific American to learn something of the attempts that are being made to break into Nature's secret store of wealth

Scores of gold-saving machines working on the gravity principle have been constructed in a vain endeavor to solve the problem amalgamating devices have been tried, but the impalpable values will not adhere to the amalgam surface, and when the particles of gold are larger, it is found often that the gold is coated or rusty or oily, so that mercury has no affinity for it.

About twenty years ago tests were made with a device using electrochemical principles (see page 205 vol I, Proceedings London Inst. Min and Met) and the results were very encouraging The science of electrochemistry has made wonderful strides in the last decade, and lately the problem of saving the impalpable values I have mentioned has been approached in a practical manner by various experimenters

It has been found that the amalgamating action of mercury is greatly increased in the presence of electrochemical conditions, and devices have been constructed to utilize this fact in a commercial way The bottom of a sluice box is covered with a copper sheet or plate, suitable electrodes (anodes) are arranged so that they may come in contact with the surface of the water flowing through the device, a solution containing a definite amount of mercuric bichloride is added to the water, and a low voltage generator is connected with the anodes and the copper plate (cathode) The mercury from the solution is deposited in its nascent form on the copper plate, forming an amalgamating surface of the highest state of efficiency The electric current passing through the water (electrolyte) cleans and brightens the gold, and all unfavorable conditions are destroyed The microscopic gold particles are coated with mercury while in suspension, and the cataphoretic action of the electric current, aided by gravity forces the values into an amalgamating contact with the mercurial surface All values are deposited in the form of amalgam, which adheres tenaciously to the plate by the electroplating action of the electric current. We have an electrolytic amalgam which is smooth, firm, tenacious yet elastic and viscid. The amalgam is not dislodged, and the mercury does not "flour" All the electrochemical processes assist in cleaning the gold, forcing it to the plate, and holding the resulting amalgam in place

A current with a voltage too low to produce a shock is sufficient to give results that are marvelous, the device is so simple that its potency would never be suspected, its cost is trifling, and any electrician can make the installation Yet the percentage of extraction is so high that ordinarily the tailings contain no values of importance

Judging from numerous tests that I have witnessed there seems to be no reason why electrochemical amalgamation should not prove to be the key which will unlock the vast hidden resources of Nature and open mining fields and mining operations which will eclipse all efforts of the past Electrochemical processes have also been used in connection with lixiviation and cyanide practice and the time of treatment reduced from 24, 36, and 72 hours to 3 hours while the extraction has been raised to 99 per cent

San Jose Cal ELMER ELLSWORTH CAREY

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THE TERRESTRIAL ORIGIN OF THE MOON—A PROTEST

To the Editor of the Scientific American

In your issue of July 17th 1909 you reprint a letter from Prof Patterson of the University of North Carolina regarding the terrestrial origin of the moon, against which I am obliged to protest Prof Patterson's views are no doubt justified by opinions heretofore adopted, but are quite inadmissible in view of my recent discoveries regarding the origin of the planets and satellites It is now proved (in A. N 4308) that not one of our planets was ever detached from the sun by rotation as very generally believed since the time of Laplace and in the same way that the satellites could not have been detached from their several planets

These conclusions were first drawn from the exact calculations based on Babinet's criterion which is simply a formulation of the mechanical law of the conservation of areas that enables us to compute the rotation period of the sun or any planet when the globe in question is imagined expanded so as to fill the orbits of the bodies revolving about it

But not content with showing that the planets and satellites could not have been detached by rotation I afterward worked out a rigorous mathematical proof of the process by which the satellites had been captured It was thus proved beyond doubt that the satellites of the solar system had originated by capture and at one time moved in independent orbits around the sun Jupiter's satellites are therefore nothing but captured planets. Though this investigation is one of extreme generality I carefully avoided reaching any conclusion in the case of our terrestrial moon till the special circumstances of the lunar terrestrial system had been investigated It was then found (1) That the moon could have been captured by the earth quite as easily as any of the satellites of Jupiter and Saturn could have been captured by those planets In fact the probability that the moon was captured, like the other satellites, was shown to be literally *infinity to one* by rigorous calculations based on the theory of probability

(2) On the other hand an independent investigation based on other phenomena showed the probability to be *infinity to one* that the earth could at no time in the past have had a rotation sufficiently rapid to detach the moon The details of these mathematical investigations have been sent to the Astronomische Nachrichten for publication and will appear very soon

It is sufficient therefore to say that the moon never had a terrestrial origin and all this terrestrial speculation is without foundation In my papers I have carefully examined the celebrated researches of Sir George Darwin and shown that he was misled by accidental coincidences As the moon never was near the earth, but is really a planet which came to us from celestial space (see cablegram of May 24th in the Astron Nachr 4325) we shall have to give up all the old views about the former rapid rotation of the earth. In the same way the mathematical investigation recently published by Prof Slichter of the University of Wisconsin in Publication 107 of the Carnegie Institution (pp 61-67) on The Rotation Period of a Heterogeneous Spheroid" is invalidated so far as concerns application to our actual earth All the bodies of the solar system have been captured, and not one of them formed by detachment from the central masses which now govern their motions Besides the investigations above referred to a further paper on this subject was presented to the Astronomical Society of the Pacific June 25th 1909

T J J SEE

U S Naval Observatory, Mare Island Cal

Luna Park, in the suburbs of Paris, is a new enterprise laid out after its Coney Island namesake at a cost of $500,000 The Temple of Mirth is packed with the usual queer contrivances such as human roulettes zigzag steps and torpedo floors The scenic railway electrically run, has tunnels and caverns Shooting the Chutes" is another familiar attraction One of the sensations is a realistic representation of the Johnstown flood which has remarkable electrical effects and which once used to thrill Coney Island There is also the Infernal Wheel and many other attractions.

THE CHRONOSPHERE—AN EMPIRE CLOCK.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN

The accompanying engraving illustrates an ingenious and useful horological novelty that has recently been perfected by an English inventor Mr J H Overton and which is described as an Empire clock As the name implies, it is a universal timepiece for not only does it give the correct time all over the world but supplies in a glance the difference in the times between all places on the earth's surface and the correct mean time at any town or place in the eastern or western hemisphere Moreover it demonstrates the actual rotation of the earth on its axis in the twenty four hours as well as the actual speed of the earth

The clock is made in two sizes and patterns but the principle of design and operation is fundamentally the same in both instances There is a terrestrial globe inclined at 23½ degrees similar to that used in schools and suitably mounted The diameter of this glove varies from 3 to 4 inches according to the size of the clock It completes one revolution about its axis in the course of twenty four hours in the same direction as the earth itself revolves Parallel with the equator is a fixed ring dial upon which are inscribed the numerals representing the twenty four hours with sub-divisions the hours from 6 P M to 5 45 A M being engraved in black and from 6 A M to 5 45 P M in red to distinguish the twelve hours before and after meridian The meridians of longitude are 15 degrees apart When any meridian is adjusted to its own mean time all the other meridians denote their own mean time and each meridian will continue to do this correctly throughout the twenty four hours In order to determine conveniently the time at any desired spot on the earth's surface relative to another point such as New York there is an adjustable and movable guide fitted with a pointer which turns with the globe and whereby the time is indicated in the hour ring just as the hand of an ordinary clock at any place This guide is held in position by means of a small knob which enables it to be turned in an easterly direction without moving or changing the position of the globe and it can be set over any town where the chronosphere is to be permanently used As an example the clock is installed in New York and it is desired to ascertain the relative time in London when it is 12 noon in the first named city The guide is set to stop over New York and the pointer indicates this city's mean time The guide is moved eastward until it is brought over London and the hour 4 46 P M is instantly shown on the ring dial The guide is then turned eastward and brought over New York upon reaching which point it will stop and click denoting that it is over the place at which it is adjusted for permanent use when it again indicates correct New York time The guide is easily adjusted to stop over any part of the globe where the timepiece is permanently used

In the second type of chronosphere the terrestrial globe is of 8 inches diameter and it indicates the relative times between any two places In this case the globe should be secured in the manner later explained before the guide is moved For instance the chronosphere is permanently used in London It is 1 o'clock there and it is desired to ascertain what would be the time in Pekin when it is 8 o'clock in Vienna The pointer is set to indicate 1 o'clock in London and the guide is brought over Vienna The globe is then turned together with the guide by means of the milled screw at the top of the sphere until the pointer indicates 8 o'clock on the hour ring By tightening the milled screw the globe is then secured in that position so that it will not revolve in either direction—east or west—and the guide is then turned until it is exactly over Pekin Instantly the pointer indicates the Pekin time on the hour ring when it is 8 o'clock in Vienna The top screw is released and the guide is carried eastward until it is brought over London when it stops The milled screw at the top of the globe is released and the latter rotated in an easterly direction until it stops itself so that the pointer once more indicates actual London time that is 1 o'clock plus the minutes that the experiments have occupied in determining the relative times between Vienna and Pekin

The globe mechanism is so designed that after displacement from local time in order to carry out any such investigations as are described above it will when brought by the hand back to the local time stop itself in the correct position for the pointer to indicate actual local time once more If desired the guide can be easily adjusted for merely permanent use as in the smaller model Moreover if required a sun attachment can be fixed in position whereby the height of the sun in degrees above the horizon is shown for every day of the year This fitting renders the clock capable of more extensive use in schools and colleges The total heights of the two models are 12 and 15½ inches respectively so that they occupy but a small space It is only necessary to bear in mind that the guide and the globe must be turned in an easterly direction only and when setting time to exercise care that the guide be over the place at which it is adjusted for permanent use and that the globe has been turned eastward until it has come to a stop

For schools and colleges the clock is especially useful since it enables one to demonstrate in the concrete the daily rotation of the earth from west to east, the difference in time arising from such rotation corresponding to the difference in longitude that is 15 deg longitude east or west one hour's difference or four minutes for each degree east or west of the standard meridian and the exact relative position of every place in the world and its exact position at any time in relation to the light of the sun that is by day or night as well as certain phases of solar phenomena by means of the sun attachment The clock requires winding only once a week and its steadiness and accuracy in running are distinctly noticeable features It should prove of marked utility to steamship and railway companies as well as to other commercial enterprises having an extensive trade overseas

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THE FIGUREHEAD AND ITS STORY.

From time immemorial the seagoing vessel whether a creation of wood and hemp or of iron and steel has presented herself as an almost human individuality to the eyes of her crew From the earliest ages those little differences between craft of the same type which are only perceptible to the trained eye of the seaman were recognized to be insufficient to distinguish one individual ship from another Hence ships were variously ornamented and named by their owners and commanders who frequently adopted one of the numerous deities of heathen mythology as especial protector of their vessel and of those who intrusted themselves and their fortunes to its keeping As in almost every branch of antiquarian research we look to the ancient Egyptians for the earliest information on the subject These wonderful people were among the very first recorded ocean travelers and shipbuilding with them had at an early date quite attained the proportions of an art Many of their boats were elaborately painted and decorated and among their decorations the figurehead stands out somewhat prominently The sacred ibis the lotus, and the phœnix were favorite designs sometimes placed on the raised up prow itself and at others rather behind it as in the one illustrated Note the huge eye that is painted on the bow just below the figure This peculiar badge is very illustrative of the general feeling that a ship is endowed with a personality of its own, and in one form or another it has maintained its position on the bows [illegible] after century up to the present day, in which it is often seen on the bows of Maltese dyed and other gaudily painted European craft, to say nothing of its almost universal use in China. "If no have eye, how can see? asks the Chinese sailor and the expression Right in the eyes of her" is still usual afloat among our own seamen meaning as far forward in the ship as possible The ships of the Greeks and Romans preserved the "eye" on their bows, and carried a distinguishing emblem or figurehead (*parasemon*) at the bow while their tutelary deities were generally given a billet at the stern All these vessels had their distinguishing devices and figureheads in addition to which those named after mountains and rivers had a lion or a crocodile respectively painted or carved in relief on either bow Numbers of representations of these may be seen on old coins

A special class of Phœnician vessels had a figurehead representing a horse and were therefore known as *hippi* the idea of riding over the sea as on horseback being evidently the origin of the adornment. It is interesting to note that in the year 113 B C one of these figureheads was found thrown up on the east coast of Africa and brought to Egypt strong circumstantial evidence that some early Phœnician mariners had already doubled the Cape of Good Hope

Ramming being the most usual form of attack among the ancients in their sea engagements the bow decoration often took the form of the head of a ram or of a wild boar the well known butting tactics of these animals rendering the figure very appropriate

When Rome in the days of her decadence lost the command of the sea the most formidable navies were those of the Scandinavian sea robbers the famous Vikings The term Viking by the way has nothing to do with the English word king as is often supposed, but is derived from *vik*, a creek or fiord and *ing* meaning the son of The word thus should be translated the sons of the fiords'—a very good descriptive name for these Norse sea rovers Their vessels—the famous long ships—were adorned with figureheads But the Viking's conception of this form of ship ornamentation started from a standpoint quite different from that of the ancients It was not so much a distinctive design or a religious emblem Its intention was to strike terror into an enemy What form of reasoning led up to it is well described by Baring-Gould in his Strange Survivals and Superstitions"

In the Egil's Saga an old Icelandic chief is said to have taken a post fixed a horse's head at the top and to have recited an incantation over it which carried a curse on Norway and the king and queen when he turned the head inland it made all the guardian spirits of the land to fly This post he fixed into the side of a mountain with the open jaws turned toward Norway These figures were called *nith stangs* The *nith-stang* was primarily the head of the victim offered in sacrifice lifted up with an invocation to the god to look on the sacrifice, and in return carry evil to the house of all who wished ill to the sacrificer

The figurehead of a warship was designed in like manner to strike terror into the opponents and scare away their guardian spirits An Icelandic law forbade a vessel coming within sight of the island without first removing its figurehead lest it should frighten away the guardian spirits of the land

Here then we have the *raison d'être* of the Viking figurehead and the annexed reproduction of an old drawing in Strutt's Chronicle of England' shows not only a figurehead of this period but actually a *nith stang* in combination with it

It is obvious that the word head comes directly from the *nith-stang* and although the advent of Christianity abolished the barbarous form of witchcraft which it exemplified yet the figurehead and hence the head' of the ship remain terms in constant use to this day In the drawing referred to it will be observed that the actual bow terminates with the head and neck of some animal which is probably intended for a dragon This fabulous monster has always been a favorite emblem in all ages and from China to Wales, in both of which widely separated countries it occupies a prominent position in the national heraldry In all cases it probably has been taken as the symbol of malevolent power capable of inflicting evil upon the human race In the Bible the dragon is always represented in this light, and its wings serpent form, claws, and fire-spouting mouth render it formidable in "the air above, the earth beneath, or in the waters under the earth" With the *nith-stang* theory before us we can well understand the old Scandinavian sea-rovers being very partial to its use as a figurehead The dragon, too, from its power was also frequently adopted as a mark of chieftainship or sovereignty It was the badge of the famous King Arthur, the ensign of the Merovingians and of the Saxons at the battle of Hastings. An-

THE CHRONOSPHERE

Showing time ring pointer or hand of clock and sun attachment.

1. An ancient Egyptian figurehead. 2. The bow of a Greek galley, B. C. 284. 3. The [illegible] of the Vikings. 4. A Saxon dragon-ship. 5. Figure on the "Mora," the ship in which William the Conqueror crossed to England. 6. A seventeenth-century Turkish ornament. 7 Italian war galley of seventeenth and eighteenth centuries. 8. Figurehead of "La Couronne," 1651 9. The bow of the "Fighting Temeraire." 10. H. M. S. "Queen," 1786 11. Figurehead of the "Vrijheid," eighteenth-century Dutch ship. 12. Figurehead of U S. frigate 'Tecumseh," now at Annapolis. 13. Figurehead of H. M. S. "Centurion." 14. The bow of H. M. S. "Royal Sovereign." 15. H. M. S. "Serpent." 16. Bow of U. S. S. "Castine." 17 Figurehead of French battleship "[illegible]." 18. "Germania" at the bow of the German battleship "Deutschland." 19. Bow of the German gun-vessel "Eber" 20. Bow of the German cruiser "[illegible]." 21. A Japanese chrysanthemum from the battleship "Asahi." 22. Bronze Victory on U. S. S. "Massachusetts."

THE FIGUREHEAD AND ITS STORY.

A Partial Solution of the Problem of Tele-Vision.

BY OUR BERLIN CORRESPONDENT

The problem of tele-vision has long been a favorite one with enterprising inventors. The many tele-photographic apparatus which have been made known in the course of the last few years are the outcome of their endeavors. But the transmission of photographs drawings, and handwriting over a telegraph wire is incomparably more easy than the instantaneous rendering of the moving objects situated at the transmitting station

It is true a solution of the problem could be attempted on the very principle underlying the construction of these tele-photographic apparatus. The various sections of a picture would be produced—not successively as in the case of tele-photography but simultaneously as well as instantaneously, without any lag and would become visible immediately without any photographic process. There are two difficulties in the way of a practical realization of this idea viz. (1) the extraordinary costliness of such an outfit (2) the sluggishness or inertia of the vital organ of most systems viz the photo-electric selenium cell

Mr Ernest Ruhmer of Berlin, well known for his inventions in the field of wireless telephony and telegraphy has succeeded in perfecting what is probably the first demonstration apparatus which may be said actually to solve the problem The writer has had an opportunity of inspecting this curious machine immediately before its being sent to Brussels in order there to be demonstrated before the promoters of the Universal Exhibition planned for next year In fact a complete and definite tele-vision apparatus, costing the trifling sum of one and a quarter million dollars is to be the *clou* of this exposition The demonstration apparatus has been produced at a cost of $1 250 and by reason of its more elementary construction lends itself only to the reproduction of the pattern consisting of squares arranged in different combinations

The pattern is thrown on a screen hung on a wall, which screen is a square divided into 25 square sections Behind each of these sections is arranged a highly sensitive selenium cell in which by a novel process inertia has been eliminated so far as possible. It thus responds instantaneously to any variation in lighting it is exposed to

At the receiving station is arranged a similar screen, divided into the same number of sections each of which communicates with the corresponding section on the transmitting screen While the actual system used in transmission is kept secret this much may be stated that a highly sensitive mirror galvanometer reconverts the fluctuations of current produced by fluctuations in luminous intensity on the transmitting screen into corresponding light variations An accumulator battery supplies current to the tele vision circuits

As soon as a perforated pattern is inserted in the projector a telegraphic reproduction of the picture appears at the very moment it is thrown on the transmitting screen The sluggishness of the cells has been overcome to such a degree that the telegraphic picture will respond practically instantaneously to any motion In fact a reproduction obtained at most in a few minutes with the photo-telegraphic apparatus so far constructed is here achieved in a fraction of a second so that several phases of a motion can be reproduced within a second

It is hard to realize what an amount of laborious work has been expended in constructing even this comparatively simple apparatus In fact each section with its selenium cell and mirror galvanometer device is an instrument of precision in itself while the final apparatus will be composed of 10,000 elements of the same kind Each selenium cell will have to be wound personally by the inventor, who never intrusts this work to anybody else

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Drawn glass is constantly becoming more widely employed in machine construction because of its extraordinary strength It is little affected by sudden change of temperature and resists the effect of fire, heavy loads and violent shocks Tests of the effect of loads show the great influence of the thickness of the sheet of glass a variation of 1/25 inch producing a considerable change of strength Glass broken by overloading exhibits numerous cracks radiating from the center to the edge In regard to the fire-resisting qualities official tests are made at Breslau by the following method The glass is first heated during 87 minutes, then it is sprinkled 1 minute, and receives the impact of a strong jet of water for 2 minutes. The glass is required to show no crack under this treatment Drawn glass is easily cleaned and transmits much light It is made in sheets about 1 1/3 inches thick measuring about 9 by 10 inches and 13 by 14 inches and capable of supporting, respectively, 23,000 and 30 000 pounds per square inch.

THE CEMENT WORK OF THE MUD WASPS.

BY S. F. AARON.

The cocoon-making habit is so common with insects, that there are only comparatively few species that do not possess it in some form or other It amounts simply to making use of a salivary secretion, which hardens and toughens upon exposure to the air Silk is a common illustration and the spider web is similar, though spun from the posterior of the animal Many insects spin this thread-like substance, others spread the saliva as a coating within the larval cell or boring, still others make an independent parchment like cocoon within the larval cell. Many Hymenoptera as the bees social hornets, ants mason wasps, etc., commonly employ the last method Many species of most orders use the salivary secretion as a glue, and remarkable illustrations of this can be seen in caddis fly cases under water, for the saliva is cold waterproof when hardened. An effect of warm water upon the insect salivary secretion is commonly illustrated by the reeling of silk from cocoons softened in warm water, and any insect cocoon is so affected.

The mud mason wasps and their nest.

a is the bulky stone-like nest construction of a species of Odynerus and from which the adult wasps have escaped; *b*, same broken open showing cells within, natural size, *c*, larva, and *d*, the adult insect that makes the nest, both enlarged, the latter brown with yellow markings. The jug like single cell of *Eumenes fraterna* is shown at *e*, natural size; *f*, the wasp, much enlarged The colors are black or brown with pale yellow markings.

A broken nest of blue mud dauber wasp and the larva, pupa, and cocoons taken from it.

The nest is the work of the adult wasp. The cocoons, brown and parchment-like, are the work of the full-grown larvæ and within which they go through their further transformation.

The common blue mud dauber wasp, Pelopæus cæruleus.

The color of the insect is a bright metallic or steel blue, the wings clouded. The body is about ¾ inch long An allied species, Sceliphron cementarium, with similar habits and as common, is brown with yellow markings.

THE CEMENT WORK OF THE MUD WASPS.

The making of strong-walled, hard-baked earthen cells does not seem to be a sufficient protection for the mud mason wasps in their larval state, and hence a cocoon is spun within the mud cell. While all insect cocoons are made by the larvæ, certain adult insects possess the power to secrete saliva and use it for nest building and as a means of protection against their enemies.

The hard, compact, durable, and waterproof mud nests of the mason wasps, superior in construction to the mere hardening of mud put together when moist, was always a mystery to the writer until after watching a blue mud dauber wasp at work on the habitation for its offspring.

The wasp makes certain off motions with its head close to its work after adding the mud in its proper place, and it was evident that this was a gluing operation for the purpose of holding together the particles of earth Upon closer examination, immediately after the wasp had finished a portion of its work, it was found that the clay was slightly sticky, as if a viscid material had been mixed with it. Finding where the wasp obtained its clay, I procured a bit of this, and forced it together on a smooth surface in such a way that it would be under no strain and would naturally adhere, then dried it carefully in the air, and found that it by no means made as strong a substance as the wasp's nest. Another experiment was to drop part of a mud nest into hot water, and the other part into cold water, and note the result. The latter piece merely softened but remained intact after soaking for nearly half an hour, while the other in part disintegrated, showing the presence of the salivary secretion through the clay. Upon taking a piece of this dissolved nest and forming it as the raw clay above mentioned was formed it was found that the material adhered far more strongly when dry The salivary secretion, therefore, is probably through the clay and within the cells of certain species, and makes the lining thereof. In what manner, however, the small and slender-bodied wasp can secrete sufficient saliva to glue together the numerous particles of its bulky mud nest is beyond understanding. Waterproof animal glue in very small quantities, mixed with clay or sand, makes a material hard to surpass for the purpose needed The clay nest of a species of Odynerus saddled on a twig or vine in the woods is almost like a stone, and even harder than many sandstones, and is impervious to the water It is difficult to understand how the little wasps can burrow out of the cells when sufficiently warm weather has brought them through their transformations.

◆

An Electric Rat Destroyer.

A new method for destruction of rats by the electric current has been lately put in use by the municipal electric station of Charlottenburg, near Berlin. The method is a patented one, and is invented by M Von Biederheim. A special kind of trap on the electric system which was constructed is said to give very good results. The current used in this case is three-phase current, working at a tension of 120 volts, which voltage seems to be sufficient to kill the rats. Direct current at 220 volts can also be employed. The animals to be destroyed, rats, mice, etc., are attracted by bait and enter the trap. By doing this they close a circuit which turns on the current. A set of wires is arranged so that they come in contact with the animals. The creatures are killed instantly There is no appreciable combustion in the present device A number of appliances of this kind can be mounted together in a large box At the electric traps it is advisable to use a method of a special contact which is put on and rings an electric bell or lights a lamp so that it can be noticed when to readjust the trap.

◆

To Distinguish American from Russian Petroleum.

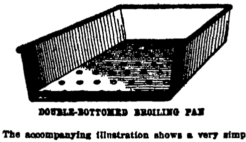
American petroleum can easily be distinguished from Galician and Russian petroleum by the action of colorless nitric acid, that is to say, acid which is not colored yellow by nitrous fumes. The acid should have a density of 1.4 and should have been freed from nitrous vapor by heating it with a little urea. Equal parts of acid and petroleum are mixed in a cylindrical glass jar provided with a ground glass stopper. The mixture is shaken violently for a minute or two. American petroleum assumes a violet color, while the acid upon which the oil floats becomes yellow. Galician and Russian petroleum, on the contrary, turn yellow and the acid becomes brown. When all three varieties are mixed together, the mixture first assumes the violet coloration, which changes suddenly to yellow after long agitation. The reaction is so sensitive that the presence of 10 per cent of Galician petroleum in American petroleum can be detected.

HOUSEHOLD SUGGESTIONS.

AN IMPROVEMENT FOR THE BROILING PAN.

BY J. A. [illegible]

When broiling steak, chops or the like in a gas-range, the suet that is tried out from the fatty part invariably catches fire. As a rule the fat is overheated and burns fiercely, and many efforts to put it out, when taken from the oven, fail



DOUBLE-BOTTOMED BROILING PAN

The accompanying illustration shows a very simple way to avoid this. In the pan used for broiling is placed a perforated false bottom made out of black iron of any thickness. The edges are turned down, say one quarter of an inch, forming supports for the bottom. This false bottom should be nearly the same size as the pan. On large pans, of course, the bottom should be braced with strips of iron, to prevent warping from the heat.

In service the suet melts, and runs down through the perforations to the bottom of the pan No matter how hot the fire, the suet will not catch fire as it is protected from the flames by the perforated bottom which acts like the screen of a miner's lamp The bottom can easily be removed and cleaned and the suet in the pan be emptied out.

◆

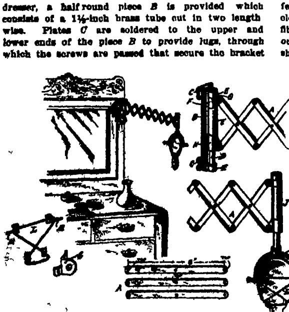
FOLDING BRACKET FOR THE HAND GLASS.

BY A. R. VAN DER VEER

A very useful adjunct to the dressing table is a small mirror, supported in such a way as to permit a person to view the side or back of the head without having to hold the glass in the hand The writer after searching the city over for an article of this character, was forced to make one for himself The task was not a difficult one, and directions are given herewith, which will enable anyone who knows anything about the use of tools to make such a bracket. Instead of having the mirror secured permanently to the bracket, it was decided to make a holder in which an ordinary hand glass could be inserted at a moment's notice. The bracket is illustrated in the accompanying drawing It is of the lazy tongs type, consisting of a series of brass links joined together after the manner of a ferryboat gate. These links are all of the same size, 6 inches long and ½ inch wide. Each of the links *A* is provided with three holes, one at the center and one at each end One set of links is provided with tapped holes at the ends only another set of equal number with tapped holes at the center only, and a third set of equal number with plain holes only

At the end which is secured to the wall, or the dresser, a half round piece *B* is provided which consists of a 1½-inch brass tube cut in two lengthwise. Plates *C* are soldered to the upper and lower ends of the piece *B* to provide lugs, through which the screws are passed that secure the bracket to its support. Two pieces of tubing are procured, one with a half-inch outside diameter, and the other a half-inch inside diameter The former is smoothed down with emery paper, so that it will slide easily into the latter A section of the smaller tube is cut to form a pintle *D*, and three pieces *E* of the latter tube are fitted on to the pintle, the whole being secured to the half tube *B* by means of screws, which pass through the sections *E* and are threaded into the pintle *D* Before the pintle is made fast a collar *F*, cut from the larger tube, is mounted thereon between the upper sections *E* To the collar *F* a lug *G* is soldered. A detail of this is shown in the drawing, and it will be seen that the base of this lug is slit to form two ears, which are bent in opposite directions, and curved to fit the surface of the collar *F* This construction provides a broad surface for soldering and is made necessary by the fact that in use this point is subjected to a great strain Between the middle and the lower sections *E* a sleeve *H* is mounted to slide This sleeve is also cut from the larger tubing A pair of lugs are soldered to this section, to receive one of the links of the lazy tongs between them It will be observed that the lazy tongs consists of pairs of links alternating with single links, the latter being the ones with the plain holes. The links are held together by machine screws, and jam nuts are used to prevent them from working loose It will be observed that the nuts for the center pivots are on one side of the lazy tongs, while those for the end pivots are on the opposite side

At the opposite end of the lazy tongs the links connect to a pair of sleeves of the larger tubing which slide on section *J* of the smaller tubing Sections of the larger tubing are fastened to the tube *J* by means of screws, so as to form shoulders thereon Soldered to the bottom of the tube *J* is a strap *K* which is bent to form a semicircle The mirror is supported in a wire frame *L*, which is bent to the form indicated in the drawing The upper ends of this frame are fitted with bolts *M*, soldered fast The threaded ends of these bolts pass through openings in the ends of the strap *K* A light spring on each bolt and a nut to press this spring against the strap *K* provide sufficient friction to hold the mirror at any desired angle. The hand glass may be slipped into or out of its holder at will



FOLDING BRACKET FOR THE HAND GLASS.

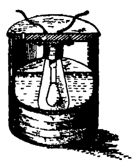
◆

ELECTRIC COFFEE POT

BY HOWARD M NICHOLS.

A simple electrically heated coffee pot can be made as follows

Procure a round tin can of about two quarts capacity This can should be about 5 inches in diameter and should be open at one end The open end should be round and smooth so that a wooden cover can be easily fitted into it



AN ELECTRIC COFFEE POT

Cover the bottom and sides of the can with heavy felt, sticking it on with shellac Put on a layer of electrician's tape over the felt and stick a piece of fiber or cardboard on the bottom Then give the whole outside of the coffee pot a couple of good coats of shellac It is very important that this part of the work be well done since if the can is not properly covered with felt, the heat generated in the coffee pot will be conducted off so quickly by the air, that it will be impossible to boil water in it.

The next step is to make a cover for the can This cover should be made from hard wood should fit tightly and should have a small hole in it to allow steam to escape A standard water-proof lamp socket should be screwed to the inner side of the cover and the leading-in wires should be brought out through small holes drilled in the cover for that purpose Each wire should be brought through a separate hole, so as to avoid possibilities of a short circuit, and wherever there are live metal parts care should be taken to insulate them as it is very easy to get a short circuit where all parts are exposed to steam

The leads from the socket should be connected to a screw plug by a suitable length of flexible lamp cord.

Screw an ordinary 32-candle-power lamp into the water-proof socket. Cover the joint with tape and shellac to keep the steam away from it.

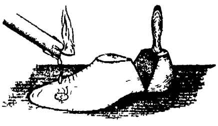
The coffee pot is now complete, and all that is required is to fill the pot with water and coffee, put the cover on with the lamp projecting down into the pot, and screw the plug into the handiest lamp socket.

◆

AN IMPROVISED SHOE STRETCHER

BY JOHN K. BRACHVOGEL.

Nearly every person at some time or other has wished he could stretch a shoe which at a particular point pinched the foot or irritated a corn It is not necessary to go to a shoemaker to have the leather stretched It can easily be done at home by means of a shoe tree of suitable form upon which an enlargement is formed at the necessary point The enlargement must adhere firmly to the tree and must be of such a nature that it can be easily molded, and that it will not become detached from the tree when the latter is forced into the shoe A material answering all these requirements is ordinary candle wax Sealing wax might be used but the candle wax is preferable as it will not injure the tree, and as it is easier to manipulate The enlargement is formed by dripping a suitable quantity of the melted wax upon the tree at the desired point, and molding the resulting excrescence into proper shape while the wax is plastic. It adheres to the tree with remarkable and unexpected tenacity and owing to its waxy nature tends to slip easily into the shoe with the tree The shoe can be slightly moistened at the troublesome part to facilitate the stretching action



AN IMPROVISED SHOE STRETCHER.

◆

TABOURET MADE FROM AN ONION CRATE

BY WILLIAM F GOEBEL.

The accompanying illustrations show how a simple crate used in shipping potatoes or onions, can be readily converted into a tabouret or flower stand

A crate such as shown in Fig 1 can be secured from any grocer or from a vegetable dealer The sides and ends of the crate which are comprised of slats arranged as shown, are fastened at their corners by a long nail passing through holes in the ends of the slats.

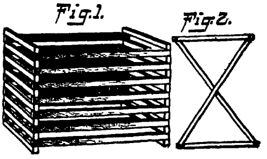
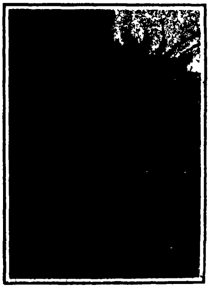


Fig. 1. Fig. 2.

COMMON ONION CRATE AND THE REARRANGEMENT OF THE SLATS.

To construct a tabouret, the nails in each corner are withdrawn and the slats being separated are then



ARTISTIC POSSIBILITIES IN AN ONION CRATE.

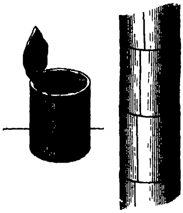
taken and slipped on the nails, and arranged as shown in Fig 2, the long slats forming a cross and the short slats arranged horizontally After the slats have been assembled, the point of the nail can be riveted holding the slats together, and producing an article of rigid construction as shown in the photograph.

The same can be stained or painted at a small cost. While the slats are fairly well planed, the appearance of the article can be improved by planing the slats a trifle more before assembling them

A TIN CAN LEADER

BY WILLIAM C. M KENZIE

A friend of mine who hates to see anything go to waste has found an excellent use for old tin cans. The rain pipes or leaders of his house are all home made, and built up of tomato cans. He claims that they are much more satisfactory than the ordinary galvanized iron leader for the reason that they were thickly coated with paint on the inside as they were built up can by can The first step in the operation was to remove the top and bottom of each can The solder was melted off by placing the cans on a hot stove After the tops and bottoms dropped off one end of each can was expanded slightly so as to receive the end of the next can which was fitted in, to a depth of about a quarter of an inch Then they were soldered together and as an extra precaution the longitudinal seam of each was re-soldered so as to close any leak that may have been sprung during the process of removing the top and bottom of the can To increase the strength of the leader the cans were so arranged that the longitudinal seams of the successive sections were staggered as shown in the illustration so as to form a symmetrical and regular spiral running around the leader Each can as it was soldered to the leader was painted on the inside wall with a thick coat of paint special attention being given to the joints After the leader was completed the outside also was protected with several coats of paint

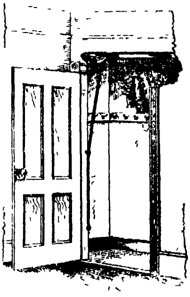

A LEADER MADE OF OLD TIN CANS.

CONVENIENT HANGER FOR THE CLOTHES CLOSET.

BY MRS. T G HORTER

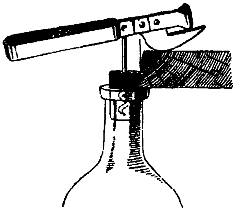
The accompanying illustration shows a hanger, for shirtwaists and other garments, located in the upper part of a clothes closet to utilize space that is usually wasted The hanger is so placed that garments hung thereon will not interfere with clothing that is hung on the usual hooks. But it may be lowered wherever desired so as to provide access to the garments thereon

The boards are fastened to the ceiling of the closet and are provided with pulleys one of which is a double pulley to receive its own cord and the cord running over the other pulley as well. The cords are secured at one end by means of screw eyes to the top of a board hanger which is provided on the under side with a row of hooks properly spaced to support the shirtwaists or other garments, one alongside the other, without crumpling them. The cords are fastened together at the opposite end and are provided with two loops for engagement with a hook fastened to the side of the door casing. One loop when caught on the hook holds the hanger in its highest position, as illustrated, while the other is used when the hanger is lowered for the purpose of hanging or removing a garment. The hanger may be raised or lowered at will by operating the cords.


CONVENIENT HANGER FOR THE CLOTHES CLOSET

SIMPLE METHOD OF PULLING A CORK.

If you own a corkscrew of the kind illustrated, you can easily remove the tightest cork without fear of soiling your clothes. After turning the screw well into the cork, place the lip of the bottle under the edge of a table or shelf, then with the upper surface of the table as a rest, lift up on the handle of the implement, and the cork will follow smoothly


SIMPLE METHOD OF PULLING A CORK

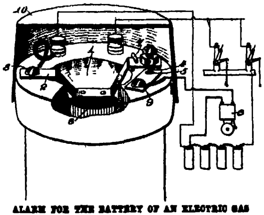
ALARM FOR BATTERIES OF ELECTRIC GAS LIGHTERS.

BY L. G. MANDY

My home is equipped with electric sparking devices for lighting the gas jets. The system as I found it had one serious drawback namely, that in some mysterious way the current would become short circuited and exhaust and ruin the battery Upon investigation, I found that a device could be bought which would give an alarm in time to correct the short circuit before the battery was affected, but that the device was attached to and made a part of a spark coil I proceeded to construct one on the spark coil which formed part of the lighting system It is an extremely simple arrangement and can be made in a few minutes

Cut away the wood of the end of the spark coil as shown at 1 in the illustration so as to get to the ends of the core wires. Bend a piece of thin sheet spring brass ⅝ inch wide into the shape shown at 2 Fasten one end with a screw 3 to the end of the coil Fix a platinum contact point to the under side of the opposite end at 4 Under this contact place the co-working contact 5 The contacts taken from an old bell will be found satisfactory To the under side of the bent portion of the piece 2 secure a small disk of soft iron 6 Care must be taken to bend the piece 2 so as to bring the iron against the core at the same time that the contact is made at the platinum points. Arrange a small stop 7 to prevent the iron rising too far from the core. The movement at the contact points should not be more than 1/16 inch, and the spring of the piece 2 should be very light. Place a small bell or buzzer 8 at any convenient point to give the alarm. This should be connected to the device as shown, one of the posts on the coil is connected by insulated wire to one of the contacts as at 3, the opposite contact 9 is connected to one side of the bell. The return wire is connected to the battery so as to place only a single coil in the alarm circuit. A cap 10 of pasteboard or other material must be used to keep out the dust.

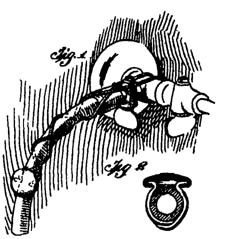
This device has been in use upward of three years, and has saved the battery on several occasions.



ALARM FOR THE BATTERY OF AN ELECTRIC GAS LIGHTER.

GAS-TUBE SUPPORT.

To prevent your gas tube from breaking where it hangs from the fixture, use a piece of spring-brass wire, 16 gage, 18 inches long. Fold this double, and wrap about the fixture as illustrated. Bend the free ends outward, and set into the under side of a large paper-tack head or similar article as in Fig. 2. This arrangement, if neatly executed, will support the tube in a graceful curve It is extremely simple, and will not prevent removal of the tube.



GAS-TUBE SUPPORT

SUBSTITUTE FOR ROD THREADER.

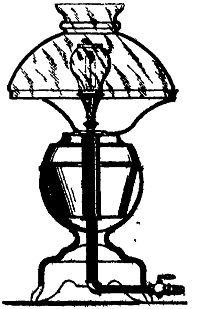
Not long ago the writer hit upon the following idea for a rod threader for quick and accurate work on rods from 1/16 to 3/8 inch in diameter All one needs is a bench or blacksmith's drill, with a three-jawed chuck Clamp the rod to be threaded in the chuck of the drill Place the die in the holder as usual hold the die against the end of the rod to be threaded, and turn the drill at slow speed Those trying this method will find it a much quicker and better way than threading by hand in the usual manner

DROP LIGHT MADE FROM AN OIL LAMP.

BY E. A. JOHNS

Since gas has supplanted kerosene for illuminating purposes many quaint and highly prized oil lamps have been put out of commission These lamps may be changed into attractive drop-lamps in the manner illustrated herewith.

A center-draft lamp is best adapted for the purpose, but any kind will answer The hole on top of the oil reservoir is first soldered up and through the central draft tube a small gas pipe is placed, with a threaded end on top, to receive the burner Any mantled burner may be used Under the burner is placed a washer, resting on top of the oil reservoir, which keeps the burner in place. At the lower end of the gas-pipe an elbow is screwed on. Between elbow and the bottom of the oil reservoir is placed a short piece of pipe, so that, when the elbow is screwed up, the tube will be tight, thereby holding burner secure to the oil reservoir From the elbow, a short piece of gas pipe is screwed in, with the ordinary stop-cock and attachment for the gas hose.


DROP LIGHT MADE FROM AN OIL LAMP.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

CLAMP FOR GARMENT-SUPPORTERS.—J. C. Copeland, New York, N. Y. The more particular purpose of the inventor is to provide a metallic member for supporting garters and the like and comprising certain parts, some of which are movable relatively to others, and so arranged as to facilitate the clasping and unclasping of the movable portions and for enabling the movable portions to spring automatically into the positions which they occupy when unclasped.

Electrical Devices.

TUBULAR INSULATOR.—L. Steinberger, New York, N. Y. The invention relates to insulators, the more particular object being to produce a high tension insulating tube suitable for insulating cables, wires, and other conductors energized by high tension currents, the tube providing a very high degree of insulation and at the same time affording great mechanical strength.

HIGH POTENTIAL STRAIN INSULATOR.—L. Steinberger, New York, N. Y. The invention relates to strain insulators used in connection with electrical conductors, and more particularly to conductors adapted to convey currents of high potential. Among its many purposes, one is to give the various parts of the strain insulator such conformity as will confer upon them a comparatively high degree of mechanical strength coupled with a high dielectric capacity.

ELECTRIC ISOLATION SYSTEM.—N. C. McClure, Healdsburg, Cal. In this invention the aim is to enable the operator on a circuit where there are a number of instruments being used, to call up or form connection with any one instrument such as a telephone, telegraph, etc., on the said circuit by ringing a bell or by other signal without disturbing the others, and when such call is answered to enable the parties to communicate with each other without being heard by others on the same line.

INSULATOR.—J. T. Bond, Palatka, Fla. The insulator is designed for use in inside and outside work and for outside work where wires pass along buildings and the like and also for pole work. Under-cut edges of an annular groove form a species of hook for retaining wires in place in certain pole work. This form of groove assists in stringing wires when constructing new lines or renewing old since the wire may be laid in its grooves during the construction and afterward secured in place.

METER LOCK.—J. H. Jackson, New York, N. Y. An object in this case is to provide a durable lock for use in electric meters and similar devices, by means of which unauthorized opening of the meter and tampering therewith is prevented and which, when the seal is broken, can be easily released and can easily be replaced.

Of Interest to Farmers.

LINT COTTON PICKER AND CLEANER.—J. L. Hart, Chickasha, Okla. The machine is adapted for picking and cleaning lint cotton either in loose form or as it comes from the bale. Cotton placed in a reception box is pushed and fed forward by a head block to the vertical run of an endless toothed traveling belt whereby the cotton is picked, subjected to the action of the air, and largely freed from foreign matter.

THRESHING CYLINDER TOOTH.—T. Dagel, Sibley, Iowa. The object of the inventor is to produce a tooth which may be easily replaced and removed, and which is firmly braced against the cylinder in the direction of the greatest strain. The tooth is not complicated in structure and is easily removed and replaced.

TROUGH VALVE.—D. I. Mauldin, Ozona, Texas. This automatic float valve is designed especially for use in water troughs wherein the supply of water is conducted from a reservoir into a trough and consumed in the latter, so that the water will be automatically supplied as the water level lowers in the trough.

VALVE.—R. H. Chalk, Sonora, Texas. In operation, as long as the float valve operates properly, the water will be shut off whenever the float is in the required position. Should the device fail to operate the trough will soon fill up with water, which passing out through an overflow pipe, enters a cup, and when this is full, a lever will swing into position, thus cutting off the inlet from the outlet, and stopping the flow until the trouble is remedied.

Of General Interest.

OAR-LOCK.—T. W. Carey, Jr., New Orleans, La. The purpose here is to improve upon the oar-lock for which application for Letters Patent was made by Mr. Carey, the improvement consisting in the material simplification and lightening of the construction without detracting from its strength, together with an improved means for regulating the rotation of the oar in its bearings, and for regulating the dip of the oar.

FILE.—E. Rustin, Atlanta, Ga. By use of this file the wrapping girl or cashier can sort the sales checks as they are received, so that those received from each salesman will at all times be filed by themselves in the order received. In use it is possible for the girl or cashier to file the sales check by one movement of one hand, and there is no danger of the sales checks being blown away by electric fans while being filed or subsequently.

FIRE-ESCAPE.—W. H. Jay, La Beau, S. D. In this instance the invention refers to fire escapes, and it has for its object to provide a standard which will permit a person to embrace it and slide to the ground, there being means to enable the person to regulate the rapidity of his descent without burning or chafing his hands or other portions of his body.

CABLE-SQUEEZER.—H. D. Robinson, New York, N. Y. The object of the improvement is to provide a device which may be easily and quickly applied to the mass of strands going to make up the cable which will force them together into a perfectly cylindrical mass, and which may be very readily loosened and moved after the permanent securing means has been applied adjacent the point last squeezed into shape.

PROCESS FOR THE PRODUCTION OF A LEATHER SUBSTITUTE.—R. Wagner, Vienna, Austria Hungary. In this case the product obtained by the process resembles leather very closely, being flexible, extensible and possesses a high degree of strength and the other physical products of leather so that it may be used as a complete substitute for that material.

FEED BAG.—D. L. Toland, Bayonne, N. J. The bag insures a liberal supply of air to the animal's nostrils and the construction is such that it will prevent the waste of grain which may fall out under the animal's throat. Such a waste often occurs on account of the habit of tossing the head in order to bring the grain within reach of the lips.

PISTON PACKING.—G. B. Thompson, Republic, Mich. The invention pertains to piston packing for air cylinders and relates more particularly to a packing ring fashioned from hard fiber generally known as indurated or vulcanized fiber and split so that it can be sprung upon the piston, the ring tending to spread against the walls of the cylinder owing to its own normal resiliency.

DIE FOR PRESSING SHEET METAL.—C. F. Steiner, New York, N. Y. The improvement refers to dies such as are used for pressing sheet metal to produce certain ornamental designs or patterns. The die is intended especially to be used for forming the risers of metal staircases. The die can be used so as to form a number of different patterns, differing materially in their general form or artistic effect.

GRAPPLE.—C. L. Simmons, Spokane, Wash. The object of the present invention is to provide a grapple for hoisting concrete blocks and other articles and having adjustable and reversible means to permit the use of the grapple for hoisting small and large blocks, and for grappling a block either outside or inside. It relates to grapples such as shown and described in Letters Patent of the U. S. formerly granted to Mr. Simmons.

CHURCH-OFFERING ENVELOP.—J. H. Earle, Richmond, Va. This invention is distinguished by the form of the blank from which the complete envelop is made, by the arrangement of the different sections of the blank so that they are to fold and form opposite pockets which are placed back to back and sealed together and have separate and opposite sealing flaps. The general form of the blank is such that it may be cut economically from large sheets and the complete envelop is of less dimension than those originally used.

DAYLIGHT DEVELOPING APPARATUS.—J. W. Merk, 34 Albert road, Stroud Green, London, England. The invention consists in providing a container with a detachable spool box which is adapted to receive the exposed spool direct from the camera and from which the film is wound into the container at same time as the apron, the spool box being then removed so as to enable the container inclosing both apron and film to be placed in a developing tank.

VENTILATOR.—J. Jacobs, Akron, Ohio. The aim of the inventor is to provide a form of ventilator for roofs, adapted to be opened and closed and at all times protect the opening from rain and snow, and when closed make a very tight connection. It is of the type employed in ventilating shafts or flues of warehouses, factories, etc.

FIRE ESCAPE.—T. R. Anderson, Oklahoma, Okla. The purpose of the invention is to provide details of construction for an escape of the inclined slideway type, which afford a safe device that is foldable at the side of a building for protection from the elements, and which may be quickly placed into position for service as occasion may require.

GAGE AND MARKING DEVICE.—A. Veitch, Canton, N. Y. The invention is for employment by woodworkers for marking out lines of mortises or open recesses in casement jambs and door stiles, to receive hinges, and it is especially well adapted for the purpose, and it may also be used as depthening and outlining gage for forming recesses in other constructions of wood or metal.

HORSESHOE-CALK.—H. W. Schoen, Scranton, Pa. In this case the improvement has reference to horseshoe calks, the more particular purpose being to provide a shoe having its calks detachably secured in position so that they may be readily removed from or replaced upon the shoe.

PAINTING APPARATUS.—G. A. Price, Chehalis, Wash. An object of the invention is to provide a device having manually operable paint brushes adapted to be provided with paint supplying means, flexible pipes for connecting the paint supplying means of the brushes with the portable tanks, and means for placing the paint in the tanks under pressure to effect a forced feed to the brushes.

EYEGLASS-CLIP.—W. G. King, New York, N. Y. The invention relates to eyeglass clips, the more particular purpose being to provide an improved construction offering various advantages of adjustment, strength, durability and ease of manufacture. The means provided enable the glasses to be adjusted to fit upon the nose without difficulty.

SQUARE.—T. C. Howland, Lock Arbor, N. J. One of the separable arms is provided with a longitudinal slot isolated from the outer edges thereof and provided with a groove at one side extending from the slot through the inner side edge, the slot being relatively wider at side of square having the groove than the opposite side, the other arm having an end portion to fit into the slot and groove, and screws and similar devices carried by one of the arms and having heads movable into engagement with the other arm and thus locking the two together.

TAILOR'S MEASURE.—M. Cierto, New York, N. Y. The invention consists of a supporting stand, an upright arm offset from and vertically adjustable on the stand, an approximately horizontal square adjustable transversely on the arm, a height gage adjustable on the square having a horizontally adjustable rule or gage vertically adjustable thereon, and tapes respectively carried by the post and squares with the tape carried by the square adjustable thereon.

WINDOW STRUCTURE.—R. Linkletter, Jersey City, N. J., and J. H. De Freitas, New York, N. Y. The invention relates to window structures, the more particular object being to provide a number of improvements for use in facilitating the lighting and ventilating of a building or portion thereof in so far as these objects can be accomplished by aid of window structures.

FOOD-WARMER.—R. W. Munn, Troy, N. Y. The aim of this inventor is to provide a warmer more especially designed for use on tables in seaside restaurants and like places, in which open air dining predominates, the arrangement being such that the warmer takes up comparatively little space on the table and allows carving and dishing of the food without removal of the dish containing the food from the warmer.

HOSE PIPE.—W. R. Calvert, Chickasha, Okla. Mr. Calvert's invention is an improvement in hose pipes and relates particularly to hose pipes comprising sections of metal pipe united by flexible connections. The sections may be of uniform diameter throughout or they may be tapered at their ends to facilitate the application of the coils.

Hardware.

FARRIER'S TOOL.—A. I. Merrifield, East Lebanon, Maine. In the present patent the invention has reference to certain improvements in farrier's tools and more particularly to a special tool for use in trimming the front portion of a horse's hoof to form a curved recess into which the clip on the horseshoe may extend.

OPERATING ATTACHMENT FOR SCREW DRIVERS, ETC.—P. S. Peterson, Ephraim, Utah. In this instance the invention pertains to improvements in operating attachments for rotatable tools, such as for instance screw drivers, bits, reamers, drills, or the like, but is especially adapted for screw-drivers as it may be employed for turning the driver in either direction.

Heating and Lighting.

HEATER.—S. Keitonik, Johnstown, Pa. The object of the inventor is to provide an improved heater, arranged to directly radiate a portion of the heat generated by the burning fuel into the room in which the heater is located, to utilize a portion of the heat for heating air to be conducted to other rooms, and to provide an escape for the dust arising from the ash pit.

LAMP.—C. M. Daniels, Paris, Ill. The invention refers to improvements in incandescent lamps, and more particularly to that type of lamp in which a liquid fuel is vaporized and mixed with air before being delivered to the burner. It involves certain improvements in the vaporizing and mixing chambers and means for regulating the same.

GRATE FOR STEAM GENERATOR FURNACES.—R. A. Farr, Melville Terrace, Bedminster, England. The special feature in this case is that the grate is composed of rocking bars which turn the fuel over several times during its passage through the furnace. The fuel is thus broken up and a light open fire is produced whereby practically perfect combustion is obtained. The stoker thus accomplishes all that can be effected by the best hand stoking by the constant use of the slicing box.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions, books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of March 13th or will be sent by mail on request.

(12116) H. B. says: Would you kindly tell me whether a sewing machine motor run on the New York city lighting circuit would run on a 110 volt alternating current? Would you also kindly tell me whether the dynamo described in Supplement No. 1558 would run as a motor on alternating current if the armature windings were all connected in the same way, or rather making the polarity of the armature magnets the same, provided it was wound with heavy enough insulation to stand the current? Have any transformers, suitable to be constructed at home, been described in the Supplement for changing alternating current at 110 volts pressure to steady current? A. A direct-current sewing machine motor is not likely to run on an alternating current, although some direct-current motors will run with the alternating current if brought up to speed before the current is thrown on. In large portions of New York city the alternating current is used. If your motor were used in one of these regions, it is all right for the current you name. We do not consider the little alternator of Supplement No. 1558 well adapted for use as a motor. Much better forms can be bought for a moderate price nowadays. We have not published any plans for a rotary converter to change an alternating current to a direct current.

(12117) E. F. W. asks: Will you kindly give a solution for removing paint from window glass? Also the amount of weight that two pieces of leader pipe galvanized 10 feet in length and 3¼ inches in diameter will support in salt water with ends closed without being more than half submerged. A. To remove paint stains on glass take 3 parts of potash and 1 of unslaked lime. Lay this on with a stick and let it remain some time when the paint may easily be scraped off. Two pieces of pipe 10 feet long and 3¼ inches inside diameter will displace 1 1/3 cubic feet of water submerged, or 2/3 cubic foot when only half under water. 2/3 × 62.4 pounds (weight of a cubic foot of water) = 41.6 pounds, which is the weight the pipes will sustain when half submerged, including their own weight.

(12118) D. H. says: In your issue of June 5th is an article headed "Auroras: Some Recent Theories." In this article appears the expression "a tropical month (27.3 days)." I have heard that expression before but do not know just what it means. A. The time you name as a tropical month, 27.3 days, is the time required by the moon to go around the heavens from a star till its return to that star again. It is the synodic period of the moon, while a lunation is the time from new moon till new moon again, which is a little more than 29.5 days. The word tropical in this sense refers to the tropic in the sky, as the Tropic of Cancer or Capricorn, and not to a zone of the earth.

(12119) B. P. asks: I wish to know the difference between iron and steel. A. Steel is differentiated from iron by the amount of carbon it contains, but the distinction is complicated by the fact that whereas any kind of steel contains more carbon than wrought iron, cast iron contains more carbon than any kind of steel. The qualities of hardening and tempering which formerly distinguished steel from iron now no longer apply, since soft steels are produced, which by ordinary blacksmith's tests will not harden. All products of the Bessemer, crucible, and open-hearth processes are described as steel. Cast steel contains from 0.06 to 1.5 per cent of carbon, according to the purpose for which it is to be used, the dividing lines between soft, mild, medium, hard, and semi-steels not being well defined.

(12120) A. L. D. asks: We have at our plant a concrete and cement reservoir six feet deep, ten feet wide, thirty feet long, but which is not waterproof, and when half full of water allows the water to seep through the pores of the cement walls. Will you please advise whether there is a preparation that can be used as paint on the inside of the reservoir which would close up these pores and keep the water from forcing through the walls and at the same time withstand the action of soda ash and lime, which we use in the water. Kindly give us what information you have or refer us to the proper authorities. A. No ordinary cement concrete is perfectly waterproof, and much of it both absorbs water like a sponge and lets it through like a sieve, a fact which builders are insufficiently aware of or refuse to recognize, many of them claiming to put up waterproof concrete, and the market being flooded with waterproofing compounds for mixing dry with the concrete ingredients, most of which are of no use whatever. Concrete can only be waterproofed by external treatment, and then with difficulty and uncertain success.

The best method for your purpose is the Sylvester process. Into each gallon of hot water required to cover the surface shave ½ pound of castile soap let it dissolve, but do not make suds, and apply to the dry concrete surface boiling hot using a wide soft brush such as a whitewash brush. After the soap solution has dried apply lukewarm a solution of ¼ pound powdered alum to each four gallons of water. Two repetitions of this process should close all pores and render the concrete waterproof. If not, try a further coat or two. There is no reason why the above preparation should be affected by soda but if it is unsuccessful you might try a coat of water glass or write to the Concrete Association of America 2[illegible] Fifth Avenue which has conducted a number of valuable experiments in connection with varied uses of cement and is glad to give information.

NEW BOOKS, ETC.

A Portfolio of Portraits of Eminent Mathematicians. Edited by David Eugene Smith. Chicago: The Open Court Publishing Company. Portfolio containing 12 plates with descriptive text on tissues. Price, $3.

The portfolio before us contains some admirable selections and reproductions of portraits of many mathematicians, such as Descartes, Pythagoras, Archimedes, Fermat, Leonardo of Pisa, Euclid, Cardano, Leibnitz, Napier, Viète, Newton, Thales, and the collection would make excellent illustrative material for the classification of mathematical industries. The portrait of Descartes is particularly fine.

How to Identify the Stars. By Willis M. Wilhelm, Ph.D. New York: The Macmillan Company, 1909. 8vo., 38 pp.; plates. Price, 75 cents net.

The ability to recognize the important brilliant stars and to locate the more conspicuous constellations is both an interesting and a useful acquirement. The number of people who have a real interest in popular astronomy and a fair acquaintance with the stars and constellations is strikingly increasing and they will find a real pleasure in this information. The object of this little book is to enable the latter persons to identify the various constellations and stars. The method here followed and the material presented is essentially the same as that used in the course of descriptive astronomy in Williams College.

Light and Sound. A Textbook for Colleges and Technical Schools. By William S. Franklin and Barry MacNutt. New York: The Macmillan Company, 1909. 8vo., 344 pp. Price, $1.60.

There always seems to be a field for a good book on the very important subjects of light and sound. The literature is already vast on these subjects but the authors have succeeded in presenting some phases in an entirely new light. There is an entire absence of the time-honored illustrations which have been copied from book to book. The diagrams and illustrations are very numerous and are well executed. The book will prove of value to all physicists.

The Rise and Progress of the British Explosives Industry. Published under the auspices of the Seventh International Congress of Applied Chemistry by its Explosives Section. London: Whittaker & Co. New York: The Macmillan Company, 1909. 4to., pp. 418. Price, $5.25 net.

This very enlightening book gives an exceedingly interesting history of British explosives, reproducing many curious engravings. This is followed by chapters on the concussion caps, safety fuses, military fireworks and pleasure fireworks. Then comes an excellent bibliography and a chronology from 1242 to 1700. The existing government and private establishments are then described. The work is highly technical but will prove of great interest to those whom it concerns.

Through the Yukon of Alaska. By T. A. Rickard. San Francisco: Mining and Scientific Press, 1909. 8vo., 392 pages. Price, $2.50.

This book records observations made in the course of a journey in the Yukon Territory in the District of Alaska during the summer of 1908. The sections devoted to the development of mining methods are particularly valuable and the book should prove of interest to everyone who has ever been to Alaska and the Yukon Territory or is thinking of doing so. We are particularly taken with the 175 illustrations, which are admirably executed. The book is well printed and bound.

Exporters' Encyclopedia for 1909. New York: Exporters' Encyclopedia Company, 1909. 12mo., pp. 655. Price, $5.

The present volume contains full and authentic information relative to shipments for every country in the world. The Exporters' Encyclopedia is now in its fifth year and is a recognised standard authority among export shippers, and has the strongest indorsement of all the transportation lines and export houses, manufacturers, etc., engaged in export trade. It gives exactly the information which exporters require to enable them to ship their goods with the minimum of expense and trouble. It is a valuable compendium for anyone who is at all interested in export trade.

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Elevator door sidewalk C S Hoffman	[illegible]
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Engine cylinder lubricator, J A Daubenspeck	928,906
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Engines, fuel for internal combustion, G B Selden	[illegible]
Engines, leveling mechanism for traction, R C Gorham	[illegible]
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Excavator shovel, [illegible], C C Jacobs	[illegible]
Fabric J L Patterson	[illegible]
Faucet J H Glauber	[illegible]
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Fertilizer distributer, W J Adams	[illegible]
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Filter F E Alderson	[illegible]
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[illegible]	[illegible]
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Glass in the heat, apparatus for working, J Kremenezky	928,870
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Gradient instrument, R Sobotka	[illegible]
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Hoe W S Davis	[illegible]
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Monkey wrench, ratchet, A C Jacobs	[illegible]
[illegible] attachment for, R R Houghton	[illegible]
Motor, J R [illegible]	[illegible]
Multiple pendant switch C L [illegible]	[illegible]
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Musical instruments, [illegible]	[illegible]
Musical [illegible]	[illegible]

ORVILLE WRIGHT'S RECORD FLIGHTS AT FORT MYER.

(Concluded from page 85.)

Mr. Wright naturally tried to follow and obliged him to make a turn to the right in order to circle around the stake balloon at Alexandria in the right direction. Upon the return trip, after passing over the top of Shuter's Hill—a high hill near the turn—a strong downward current drove the machine toward the earth, and the aviator was obliged to set the horizontal rudder sharply upward in order to regain his proper elevation. After doing this he flew steadily back to the starting point and crossed the line 14 minutes and 42 seconds after first passing over it on the outward journey Deducting the time of the turn at the far end of the course, the time for the 10 miles was 14 minutes and 12 seconds, which corresponds to a speed of 42.35 miles an hour This means that the Wrights will receive a bonus of $5,000 in addition to $25,000 they bid for supplying a 2-man machine. The flight was made with Lieut. Benj. D Foulois as passenger, and, save for the points mentioned above, was uneventful according to Orville Wright. The precision with which he maintained his level while flying over a valley 200 feet or more in depth on the outward trip was remarkable, and had not the downward wind current caught him on the return trip, he would have accomplished this just as well. The undulation and veering out of the course owing to the wind doubtless made a slight diminution in the speed Had there been no wind the brothers might have made faster time and obtained a greater bonus. But, on the other hand, a flight under such conditions as obtained was a far better demonstration of the possibilities of the machine for war purposes, and the Signal Corps may well be proud of its first war aeroplane, which is without doubt the premier machine of the kind in the world to-day

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THE FIRST SUCCESSFUL CROSS-CHANNEL FLIGHT.

(*Concluded from page 88.*)

when the motor slowed down and stopped and he again came down in the Channel. Although his monoplane struck the water rather more gently than on the previous flight, Latham's nose was broken and his head cut open by his broken goggles, so forcibly was he thrown against some of the guy wires of his machine. Nothing daunted, however, he has announced that he will again make the attempt as soon as he recovers. Thus has been opened a new era in aviation—the era in which the flying machine is to be used for traveling from one country to another, be it over land or sea.

The triumphant 25-mile flight of Bleriot across the English Channel, which was accomplished in 37 minutes, or at the rate of about 40 miles an hour, is the culmination of a large number of more or less lengthy, yet successful flights that have been made by this aviator with his "No. XI." machine since it was first brought out last January Some of the more recent of these flights we mention herewith.

During the past two months, M. Bleriot has been experimenting almost daily with either his "No XI." or "XII" monoplane. The former of these he has kept at Issy-les-Molineaux, while the "No XII" machine has been at Douai On June 8th he made two excellent 500-meter flights with the latter at Issy-les-Molineaux, the first alone, the second with his mechanic as passenger On June 11th he made several short flights of from 500 to 600 meters in length, keeping the machine close to the ground; and afterward a magnificent flight of fully a mile, which was terminated by a double S turn at a height of 15 feet. With M. Guyot as passenger, another flight of 1¼ kilometer (nearly 1 mile) at a height of 7 meters (23 feet) was accomplished. The following day M. Bleriot made a straight-line flight of about 250 meters (820 feet) with Santos Dumont and A Fournier as passengers. This was the first time that three people had flown in an aeroplane. The same day several other flights were made with one passenger, the longest of these being about a mile in length at a height of 30 feet. By himself Bleriot afterward flew about 3 miles.

On June 14th Bleriot made some more flights with his 'No XII" monoplane After a short flight of 4 kilometers (2½ miles), he landed to repair his magneto As soon as this was accomplished he made a magnificent flight of 10½ minutes duration, in the course of which he turned his machine in all directions and executed various maneuvers that demonstrated thoroughly its stability Several times he took his hands off the steering wheel The next day, after making a 5-minute flight at a height of 20 feet, he flew with a passenger, but the flight was stopped by the breaking of a connecting rod of the 8-cylinder motor

On June 18th, Bleriot began flying again his "No. XI" monoplane, fitted with a 3-cylinder Anzani air-cooled motor of about 25 horse-power. He made a flight of 4 kilometers (2½ miles) On the 21st he made flights of 3 and 6½ minutes, the motor stopping from lack of oil Just as he was starting on a third flight, the exhaust from the motor set fire to the gasoline in the carbureter, due to the latter being placed too near to the exhaust pipe. The flames were quickly extinguished with sand.

On June 25th he took out his machine about 7 P M., and, notwithstanding a quite heavy wind, he flew for 15½ minutes, making about 12 circuits of the parade ground and showing perfect stability in spite of the violent wind gusts. Each time he passed over the aeroplane shed he took his hands off the steering wheel The flight was terminated because of too much oil which fouled the spark plugs. The flight was officially timed by M. Ernest Zens. At 7 A. M the next day Bleriot made a record flight consisting of 20 circuits of the parade ground in 36 minutes 55 3/5 seconds In the early evening he made three more circuits.

On Monday, June 28th, Bleriot started making flights at Douai with his No XII" machine. He won the first of five prizes of $400 each in a magnificent 1½ mile flight at a height of 65 feet. In a second flight made on this day, he carried a passenger once around the field

On June 30th, he tried to break his previous record at Issy with his 'No XI" machine, but after flying only 650 feet, the engine stopped on account of too much oil. Shortly after he remedied this trouble, and then made four excellent circuits of the parade ground at a speed of over 37 miles an hour The time of the flight was 6 minutes, 11 seconds. There was a gusty wind of from 15 to 20 miles an hour More lubrication trouble was the cause of his alighting

On July 4th Bleriot set up a new record at the Aerodrome at Juvisy This record was made at an aeronautic meet for the benefit of the many people who suffered from the recent earthquake in the south of France. The flight this day was made with the 'No XI" machine. After making one circuit of the course, Bleriot started upon his long flight This flight lasted 50 minutes and 8 seconds. It was brought to a close through trouble with the gasoline feed The flight was made at a height that varied from 50 to 80 feet, and it was the best Bleriot had made up to that time.

On July 9th and 10th, at Douai, he made several flights before 20 000 spectators, but his greatest performance prior to that of July 25th was his cross-country flight of 25 miles on July 13th This flight from Etampes to within 8 miles of Orleans was accomplished early in the morning and was broken by a descent in a field near Barmainville The flight was for the "Prix de Voyage" While it was not necessary to make a descent, Bleriot chose to do this so as to show

(*Concluded on page 100*)

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the practicability of his machine Soon after he started up again Bleriot passed Toury and Dambron As he came in sight of Artenay which was the half way point of the cross-country flight last year a rather strong wind from the west caused him to make a semi-circle He flew sufficiently high to clear the telegraph wires and then came to earth on the selected spot at Croix Briquet-Cheville The start was made at 4 44 A M and the landing took place at 5 40 Deducting the 11 minute stop the net time was 45 minutes and the distance 41 2 kilometers (25 58 miles) The average speed was therefore 34 1 miles an hour In making this flight Bleriot received a prize of 6 000 francs as pilot and 4 000 francs as constructor The motor manufacturer received 3 000 francs and the designer of the propeller 2 000 francs All these prizes are conditional upon the performance not being beaten before the first of next January The practicability of Bleriot s machine is shown by the fact that 45 minutes after he had alighted the machine had been taken apart and shipped back to his factory at Neuilly near Paris

M Bleriot s two latest aeroplanes have been illustrated and described heretofore in our columns but it would perhaps be well to give the particulars of these machines again at the present time The spread of the No XI is 7 8 meters (25 58 feet) and the length of the body 7 meters (22 96 feet) The lifting surface is 14 square meters (150 69 square feet) The machine is equipped with a 3-cylinder Anzani air cooled motor which weighs 60 kilogrammes (132 27 pounds) complete in running order A 2 1 meter (6 88 foot) diameter Chauviere wood propeller is driven direct from the motor Complete with Bleriot (whose weight is said to be 195 pounds) and with fuel sufficient for a two hour run the No XI machine weighs but 300 kilogrammes (661 38 pounds) It rises in the air at a speed of 55 kilometers (34 17 miles) per hour when the surfaces are loaded to the extent of 22 kilogrammes per square meter (4 46 pounds per square foot) This is about double the weight carried per square foot of surface by most biplanes It is probable that this machine which is the smallest and lightest that Bleriot has built is able to raise even a greater weight It might perhaps carry an extra passenger although this has not yet been tried The plane is said to be warpable somewhat similar to those of the Wright biplane Consequently there are no wing tips The No XII monoplane on the other hand has rectangular balancing planes attached to the body framework just below the aviator s seat It is somewhat surprising that planes so near the center of the machine will work satisfactorily for this purpose but photographs of the No XII making a turn show that it tips very little Bleriot has two vertical surfaces on each side of the body at the front end and he has also covered the framework about half way back to the rear end and placed a fin keel above it As a result of all this vertical surface the machine does not tend to skid very much in making a turn and consequently it does not have to be tipped inward to counteract the effects of centrifugal force

The No XII monoplane has a spread of 9 meters (29 52 feet) and a surface of 22 square meters (236 8 square feet) It is equipped with an 8 cylinder V type E N V motor of 0 35 horse power The total weight of the monoplane in running order with water in the radiator but without fuel is 350 kilogrammes (771 61 pounds) With Bleriot Santos Dumont and A Fournier on board and with 16 kilogrammes (35 27 pounds) of fuel the total weight was 560 kilogrammes (1 234 58 pounds) Therefore this machine which weighs only 350 kilogrammes (771 61 pounds) carried a dead weight of 210 kilogrammes (462 97 pounds) The total weight lifted per square foot in this instance was 5 31 pounds—an altogether unprecedented amount. The machine rises at a speed of 55 kilometers (34 17 miles) per hour with 25 kilogrammes per square meter (5 12 pounds per square foot) loading of its single surface. The weight lifted per horse-power varies from 35 to 41 pounds, according to whether the motor is taken as developing 35 or 30 horse-power This monoplane is therefore by far the most efficient aeroplane flying machine that has ever been constructed

After his record flight M Bleriot was presented with a gold medal by the Aero Club of Great Britain and also by the Aero Club of France A few days before, he and Gabriel Voisin had been awarded the Osiris prize, which is given every three years to the men who make the greatest advance in science He was also decorated with the ribbon of the French Legion of Honor as were the Wright brothers In addition to winning the prize of the London Daily Mail ($5 000) Bleriot also won a prize of $2 500 offered by a French wine firm two years or more ago The Alaska Yukon Exposition has put up a prize of $25 000 for a race between Bleriot and the Wright brothers

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ELECTRIC LAMPS IN THE MAKING

(Concluded from page 89)

the bulb are then joined together The operation is known as tubulating and the tube thus made temporarily a part of the bulb furnishes the means for the removal of the air inside at almost the final stage in the manufacture of the lamp

With the filament now made and the bulb washed cleaned dried and tubulated the filament-bearing stem and the bulb proper are assembled at one machine The operation of sealing these two parts can best be likened to inserting a stopper in a bottle the bulb being the bottle and the stem the stopper A girl inserts this stem into the neck of the bulb and both parts are revolved on the sealing machine into jets of flame where they melt together Knowing the exact amount of glass that must be melted away and the shape the molten glass will assume when it cools the operative is able to unite the stem and bulb skillfully

Then the bulb goes into another tray along with other bulbs and is taken to a girl in the vacuum room This girl is seated before an earthen pot in which there is a bubbling liquid—phosphorus in a liquid state—which is kept stirred by a jet of water She takes the bulb and with a brush hardly larger than a knitting needle coats the air-extraction tube with a phosphorus solution

After this the bulb is ready for the exhaustion of the air and final sealing Already the air has been drawn from the bulb several times in the processes of manufacture but each time the bulb has been left unsealed It is now ready for the final air test The tube at the big end of the bulb, through which the air is withdrawn by a most ingenious pump is to be sealed by melting

When the bulb is placed in position for exhausting the air the wires running through the neck are connected with an electric current which causes the filament to glow If it were allowed to glow more than a few seconds with oxygen present in the air the filament would burn up and collapse So, while the tube is connected with the vacuum pump, the operative touches it with a blue flame spray which melts bulb and stem apart, and the melted end next to the bulb draws up and closes automatically, leaving the little point seen in the finished bulb over your desk or table Before the sealing is completed the light within the bulb has a bluish cast, and this reveals the fact that all the oxygen has not yet been withdrawn from the bulb It is then that the coating of phosphorus in the air extraction tube plays its part. The heat upon the tube converts the phosphorus into a phosphorescent gas, and this gas, entering the bulb, neutralizes the oxygen in the bulb Almost instantly the color of the bulb changes from blue to white In this manner the operative

(Concluded on page [illegible])

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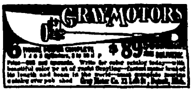
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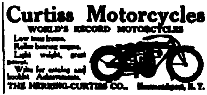
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knows that the effect of the oxygen has been overcome.

The bulb is next taken into the photometer room for the purpose of making final tests. It is a large dark room divided into several small stalls. In each stall is an induction coil, from which the bulb is held about two feet away The induced current from the coil passes through the body of the operator to the bulb, and causes the filament to glow faintly If the glow is bluish gray, it shows that there is still a leak somewhere, although it may be so infinitesimal that it can scarcely be measured by mils. If the glow is of a purplish hue, it shows that there is air still within the bulb and that the bulb must be further exhausted. This means an operation involving many more handlings.

The next process is the measurement of the bulbs for voltage, a work of the greatest possible delicacy Two girls, working together, do the measuring. One places the bulb in connection with a current that lights it, and the light from it shines through a small aperture upon a white paper screen. In the center of this screen is a faint star-shaped spot. It requires a certain voltage in the light to bring out this spot.

When bulbs pass the tests and measurements successfully, they are then ready for the appliances with which they are attached to the current-carrying fixtures in general use. They are taken to another part of the factory, where a girl places them in a tray Threaded brass collars are placed about the necks, and the space between the collars and the necks is filled with plaster cement The tray revolves through a heating oven that bakes the cement into a hard and holding mass. The ends of the wires running through the necks are cut off, small round brass plates are placed on the ends, the wires are soldered fast, and the lamp is completed.

Once more there is a sort of farewell test for leakages that may have escaped notice or may have developed from the last handlings. This final test is very quick and simple The sealed ends of the bulbs are held against two electric poles. If the lights are white and perfect, the lamps are considered ready for the last cleansing of the glass, classification, and shipment. Throughout the entire process of development of the bulb into a perfect lamp there are scarcely ever any broken This is really remarkable when it is remembered that the bulb is not only picked up many times and placed in machines, but is heated and cooled many times.

◆

THE FIGUREHEAD AND ITS STORY

(*Concluded from page 92*)

other meaning of the word dragon denotes watchfulness, so that it is not surprising to find that the *drakkars*, or dragon ships of the Vikings, generally belonged to their chieftains and were the largest ships in their fleets. The next largest were generally *snekkers* or "long serpents" with snake figureheads. In both cases the hull of the vessel played the part of the monster's body, the stern often terminating in a representation of its tail But although the dragon and serpent were the favorite devices they were not the only ones that did duty at this period as figureheads. When Sweyne, King of Denmark, made a descent on the Norfolk coast in 1004, his own ship "The Great Dragon" was made in the form of the animal whose name it bore; but the bows of the other vessels of his squadron were adorned with the figures of lions, bulls, dolphins, and men, all made of gilded copper

After the Norman conquest the figurehead disappears from view for some centuries, and it is not until the reign of Henry V that we again find references to its use. Images of the saint after whom a ship was named used, it appears, to be sent on board in the time of Edward III, but there is no record of their having been utilized as figureheads. The reason of their temporary disappearance was the gradual changes in the status of navies and in the build of the ships of which they were composed The fast oar-propelled long-ship, built only for speed and for war gradually gave place to the round-ship relying on her sails and built primarily for commerce and the conveyance of mail-clad nobles and their men at arms to the country where they intended to carry on a campaign Fierce sea fights certainly took place from time to time but for this purpose any ships that could be assembled together were utilized and prepared for action by the addition of stern and fore castles, built up stages or platforms which overhung the actual stem and stern of the ships and left no place for a figurehead In process of time the square bow platform or forecastle became triangular and its foremost extremity once more offered a suitable position for the figurehead Gradually, too, the king became possessed of a certain number of ships of his own the nucleus of a royal navy These vessels though occasionally hired out as merchant ships, were more or less elaborately decorated and among other decorations the figurehead reappeared Thus in the year 1400 the Good Pace of the Tower had a large golden eagle with a crown in his mouth as figurehead and in representations of ships during the fifteenth century little, insignificant figureheads are here and there to be met with The famous 'Henri Grâce à Dieu' built in 1514, had a squatting lion as figurehead while the big French man-of-war 'Grande-Françoise built at St Nicholas de Leure in 1527 was decorated forward with a salamander above which was placed a statue of St Francis. The Elizabethan men-of-war seem generally to have been ornamented with figureheads, but with some exceptions they were neither very large nor very noticeable At this time a long almost straight projection ran abruptly out from the bow of the ship a little way below the bowsprit It was very different from the gracefully curved stem which in the seventeenth and eighteenth centuries replaced it and would not in all probability, support any very great weight at its extremity Still it often carried a figurehead of sorts Thus the "Ark Royal' Effingham's flagship in the Armada fight had a mild looking bird as figurehead The Bonaventure and others had dragons on their beakheads others had lion figureheads one at any rate being gilded The Mary Rose' had a unicorn the Swiftsure a tiger while the White Bear was adorned with an image of Jupiter sitting upon an eagle with the Cloudes. In Holland the Finis Belli the earliest ironclad, bore the figure of a man in armor at her bow About the time of James I equestrian figures were introduced as figureheads and in succeeding reigns these were surrounded with other figures forming a most elaborate bow decoration Thus the famous Sovereign of the Seas launched in 16 7 had on her beakhead the figure of King Edgar on horseback trampling upon seven kings The figurehead of the Commonwealth ship 'Naseby' was equally exuberant consisting as it did of the Protector on horseback 'trampling upon six nations It was evidently a colorable imitation of that borne by the Sovereign of the Seas. Curiously enough this was the ship in which Charles II returned to England at the Restoration In honor of this she was renamed the Royal Charles." She was fitted with a new figurehead which is now in the museum at Amsterdam, the ship having been captured by the Dutch when they came up the Medway Furtenbach in his "Architectura Navalis' published a few years earlier gives an engraving of a very peculiar figurehead which terminated the beakhead of a Turkish pirate brigantine of a class known as *caramusels* It is probably intended to represent a drag

(*Continued on page 103*)

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Sewing machine tuck creaser F W Beckert	[illegible]
Sewing tool C E Betts	[illegible]
Shade and curtain pole bracket adjustable A L & C L Rosenbrink	[illegible]
Shade bracket, H Wittmann	[illegible]
Shade bracket and curtain pole support, combined R N Jeffery	[illegible]
Shade fixture window D Hoyt [illegible]	[illegible]
Shampoo tray C R Lovett	[illegible]
Sharpener file J C Rink	[illegible]
Sharpening file J C Rink	[illegible]
Sharpening machine saw G H Robinson	[illegible]
Sheet feeding device F B Davidson	[illegible]
Sheet metal structures uniting the component parts of composite A F Rietzel	928 701
Sheet metal wheel sectional J P Craven	[illegible]
Shingles from paper pulp apparatus for making, J T Collins	[illegible]
Shoe polishing machine E F Stratton	[illegible]
Shoe rack W F Atwood	[illegible]
Shovel A Schulte	[illegible]
Shuttle operating device G Schwahn	[illegible]
Sign board structure M P O'Brien	[illegible]
Sign, illuminated letter C E Shafer	[illegible]
Signal Kennedy & Gleason	[illegible]
Silicon alloys manufacturing A Stadeler	[illegible]

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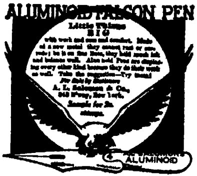

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[illegible] head, and [illegible] [illegible] them in its mouth. It [illegible] [illegible] some kind of a gun may have been mounted inside the figurehead with its muzzle concealed in the monster's mouth.

The French were always noted for the excellence and beauty of their warships, and it is not to be supposed that their ornamentation was a whit behind that of their English contemporaries. As a matter of fact they were, if anything, the more elaborately decorated of the two and often expensively gilded.

The lion about this period became as favorite a figurehead in the French and English navies as was the dragon among the Vikings. Sometimes he was rampant and fierce; at others he assumed a calm and majestic attitude. The lion went out of fashion in the French fleet after a short time, but was retained rather longer in the British service and adopted very extensively by the Dutch navy. The "Vreyheid," Admiral Winter's flagship, had a lion figurehead. Later full length figures, often of a classical nature emblematic of the name of the ship they ornamented, quite ousted the king of beasts, and these lasted right up to the beginning of the ironclad period between 1860 and 1870. There were a few exceptions to the lions and the full-length figures that succeeded them, notably the figurehead carried by the Britannia of 100 guns in the reign of William III, which was an elaborate representation of the royal arms embellished with scrollwork and other devices, and that which adorned the Victory at Trafalgar, which was also the royal arms with the figures of a seaman and a marine as supporters. Some years afterward these were transformed into a pair of cherubs. But the full length—or more often the three-quarter length—figure continued to ornament the bows of all classes of men-of-war right up to the beginning of the ironclad period.

The French were ahead of everyone in launching the first seagoing ironclad—La Gloire. She had no figurehead, but the Warrior and the Black Prince, a pair of sister ships, which England constructed in reply, were ornamented with two of the finest figureheads that have ever been made. But both these ships had overhanging or swan bows, while their successors had the ram bow, which did not lend itself so well to this style of decoration, and a shield or coat of arms surrounded with more or less elaborate scrollwork became the vogue for the bows of an ironclad. There were exceptions of course, especially in ships of low freeboard. Thus the figurehead of the old Royal Sovereign turret ship (which by the way was an old wooden line-of-battle ship cut down) was unique in having a lion standing at the top of the stem above the medallion of Queen Victoria, which was below it. The "Rodney" and "Centurion" both had bust figureheads illustrative of their names, while the French battleship "Brennus" was decorated in the same way with a very fine piece of wood carving. At this period there were plenty of small craft among the warships of the world which still preserved the swan bow, and with these the older style of figurehead still preserved its supremacy. H. M. S. Iris, for instance, had a beautifully designed angel, while the unfortunate gunboat "Serpent," wrecked off the Spanish coast, bore a snake. Toward the end of the nineties the figurehead began to disappear altogether from the British and the French man-of-war. The principal reason alleged for the abolition of the figurehead in England was that it got in the way when rigging out the torpedo-net defense, which on its part often damaged the ornamentation, necessitating an expenditure on repairs. Probably the initial cost was also thought to be an extravagance. But the practical and economical Germans have retained the [illegible]

(Concluded on page [illegible])

figurehead in their new and formidable navy and have evolved some very handsome specimens despite the ram bow What, for instance, could be more decorative and appropriate than the fine figure of Germania on the bow of the "Deutschland," one of their very latest battleships? The scrollwork on the cruisers 'Bismarck" and 'Eber' is also very artistic The probability is that the German Admiralty regards *esprit-de corps* as a very valuable and practical asset and thinks that nothing is ill spent which in any degree serves to stimulate this feeling. Certainly in the old days seamen venerated the figurehead of their floating home in much the same way that a regiment adores its special and distinctive badge 'So now my lads," said Capt Hall when in command of a frigate on board of which there was an epidemic of bickering and quarreling among the ship s company If this be not put an end to and hearty good-will restored, *I'll blacken your figurehead* and put the ship in mourning The threat had a most salutary effect, and the handsome bow-ornament shone resplendent to the end of the commission

In the far East the Japanese and Chinese have one uniform bow decoration for their men-of war, the former using *a conventional representation of the Im*perial chrysanthemum and the latter the national dragon with the head of a camel, the horns of a deer the eyes of a rabbit, the ears of a cow, the neck of a snake, the belly of a frog the claws of a hawk, and the palms of a tiger

In the United States the figurehead has followed much the same lines as in Europe That of the Chesapeake" famous for her duel with the 'Shannon," can be seen in the gardens of Ashford House in Woolmer Forest. That of the "Delaware,' representing the Indian chief Tecumseh, is in the grounds of the naval academy at Annapolis, and is saluted by every cadet when he passes it, lest haply the omission to do so should bring him ill luck in the passing-out examination Though not on so elaborate a scale as in the German navy, the United States ships, even of the newest types, are still decorated with scroll work at the bow and in some cases a new departure has been made in placing a handsome full-length figure or figures of bronze on the foremost turret between the two bow guns. The Massachusetts," for instance has a most handsome and decorative figure of a Winged Victory which was presented to her by the State whose name she bears, while the "Kearsarge" and "Alabama"—whose former namesakes fought so desperately with each other off Cherbourg in 1864—have similar decorations symbolizing in the figures the North and South clasping hands, a reunited country

This seems an excellent idea and one that might well be followed in all navies. A bronze figure on the foremost turret would more than replace the figurehead of former days It would unless destroyed in action, be practically everlasting and be passed on from one ship to its successor of the same name It would be a far better and more appropriate heirloom than the services of plate which it is becoming the custom to present to various ships. Being carried inboard instead of outboard it can be seen and admired day after day by the ship s company, which was not always the case with the figurehead even in its palmiest epochs. May we in conclusion express a hope that the time-honored figurehead may in this form rise "phœnix-like from its ashes" and be once more promoted to a place of honor in the world's war navies?

◆

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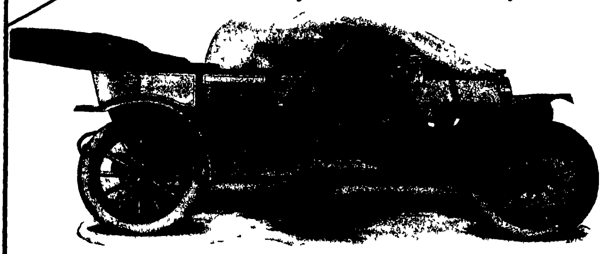

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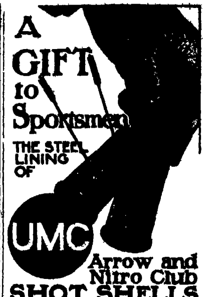

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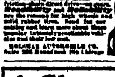

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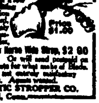

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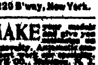

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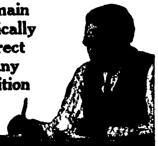

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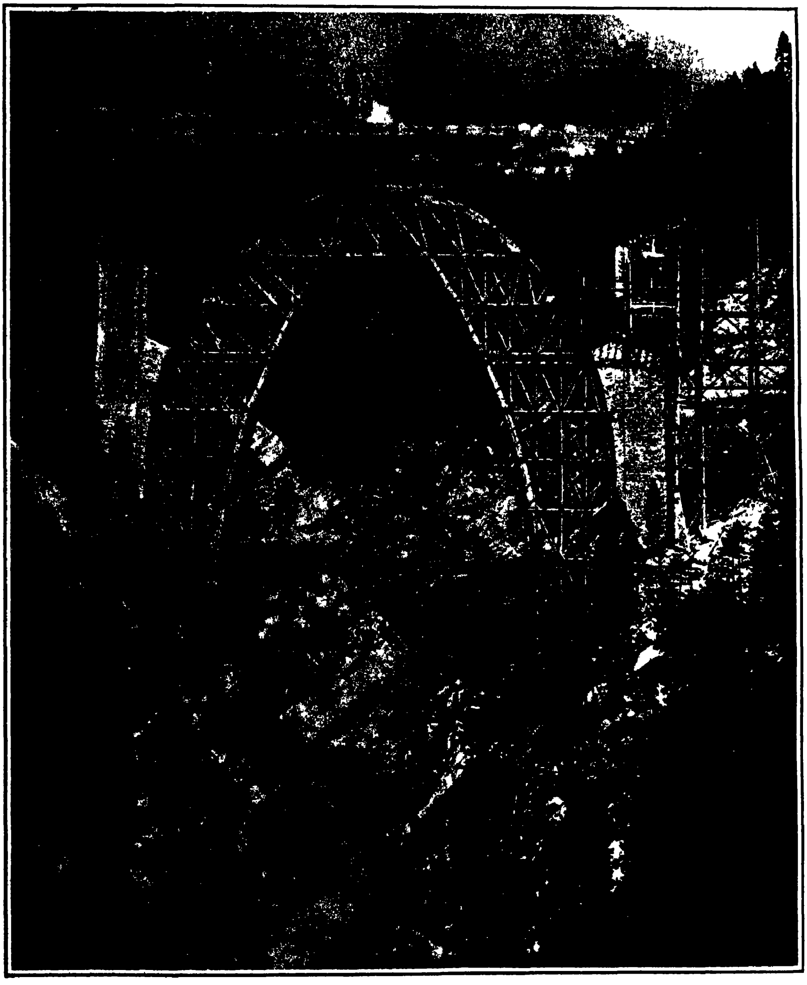

The central span is 182 feet long and towers 300 feet above the torrent below.

FALSE WORK FOR THE GREAT MASONRY VIADUCT BETWEEN WIESEN AND FILISUR, SWITZERLAND.—[See page 111.]

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NEW YORK, SATURDAY, AUGUST 14th, 1909

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

WANTED—A RELIABLE AEROPLANE MOTOR.

Unless the builders place at the disposal of the aeronaut a motor which can run with absolute reliability as long as there is a pint of fuel left in the tanks, further progress of the aeroplane, at least as regards length of flights, seems destined to be greatly retarded. Not many moons ago a 24 horse-power automobile set out upon the roads of Massachusetts to see how far it could travel without a stop. It ran ten thousand miles. To-day the aeroplane operator takes his seat, grasps his levers, and starts his engine with the forlorn hope that it may continue to run until he has covered some modest stretch of time or space. Every moment that he spends in the air he is watching anxiously for the first signs of that fatal 'missing' which marks the probable end of his flight. Latham, with a machine which is apparently perfect in balance and control, sweeps easily through the first half of the distance across the English Channel, when suddenly motor trouble begins and he must perforce float ingloriously into the sea. The Wright brothers, with an aeroplane which is the perfection of lightness, strength, and control at the present writing, have spent some weeks in Washington wrestling with the obstinacy of their motor.

Apart from its motor, the aeroplane must be considered to have already reached a high stage of excellence. Instances of failure of the planes while in the air are very rare; indeed, we do not recall a recorded instance for many months past of the failure of a flight through the breaking of the wings or body of the machine. The control, in the best machines, appears to be perfect.

Why is it, one asks, that an internal-combustion engine which will drive one machine over a continuous stretch of ten thousand miles of country without stopping, cannot drive another machine through the air without showing all the eccentric obstinacy and the hundred and one ways of breaking down which characterised the motor of the early days of the automobile? The anomaly is certainly difficult to explain, and we can only suggest a few of the conditions, which in the aggregate may account for the present unreliability of the gasoline motor in aerial work.

In the first place, then, many if not most of the aeroplane enthusiasts are obsessed by the fetish of "light weight," and under this obsession they make the mistake of trying to build a light-weight motor of their own. The result is a machine which is usually too frail for its work. The problem is further complicated by the fact that this motor is mounted upon what at best is an unstable platform. Now, as a matter of fact, the duty laid upon the aeroplane engine is far heavier than that upon the automobile engine; for whereas the latter runs at from 800 to 900 revolutions per minute, the aeroplane motor is always being driven at its highest speed, which is usually from 1,200 to 1,400 revolutions per minute. The automobile engine is mounted on a very rigid steel frame, designed to maintain everything in true line; whereas the frame of the aeroplane is light and flexible, and where gearing is interposed between crank shaft and propeller shaft, there is a liability of the parts being sprung out of line and twisting and wrenching stresses set up. Where the engines are run at such high speed, particular care should be taken to insure that the parts function properly. Magneto ignition, forced lubrication, ample cooling surface, whether by air or water, and generous bearing surfaces in the wearing parts, should characterize every aeroplane motor. Reliability rather than excessive weight-saving should be the first consideration.

The time is ripe for some firm in this country, that has had long experience in motor construction, to take up the building of motors specially suited to the aeroplane and the dirigible. These motors should embody the ripe experience and the high-class materials and careful workmanship which characterize the best automobile motor practice at the present time. There is no essential condition of the problem to prevent the construction of an engine that will drive an aeroplane in the air continuously until the last drop of gasoline has been drawn from the tank. Practical aviation is to-day awaiting the production of a thoroughly reliable motor.

A SENSIBLE "CIVIL CALENDAR."

We have received from an advertising firm in San Francisco a copy of a proposed calendar, whose aim is to avoid the acknowledged drawbacks of the Gregorian calendar by substituting one that is better suited to the requirements of our day-by-day life. "Although the Gregorian calendar dates from the year 1582, long before that many and various improvements had been suggested for conveniently dividing the 365 days of the year into weeks and months. Our correspondents ask: "Are we not again far enough advanced beyond the times of 1582 to adopt certain other changes?" and they offer a calendar which divides the 52 weeks of the year into 13 months, each having exactly 28 days. The first of January and the first of every one of the twelve succeeding months fall on a Sunday, and the 28th or last day of each month, therefore, falls on a Saturday. The obvious advantage of this arrangement is that, since each day of the week must be one of four numbers out of the 28 (Sunday for any month of the year being either the 1st, 8th, 15th or 22nd; Tuesday either the 3rd, 10th, 17th or 24th, etc.), if one knows the day of the week it is possible to find the day of the month quickly and without reference to a calendar.

The additional month necessary under this system is named by its sponsors "Vincent," and it is placed in the calendar between June and July.

Thirteen months of 28 days each, however, give a total of only 364 days for the year, and, to accommodate the odd day, it is proposed that between Saturday, the last day of December, and Sunday, the first day of January, there should be a day to be known as 'Anno Day.' It is not recognized as a calendar day, and beyond its name, has no other distinction to separate it from the last day of December. Any labor done on Anno Day would have to be a matter of special contract or agreement. No interest or rental will accrue upon that day, and for all such purposes it would be considered a part of Saturday, December 28th. Leap Year is provided for by an extra day between Saturday, Vincent 14th, and Sunday, Vincent 15th. This would be known as "Mid-anno Day" and it would be treated in all respects similarly to Anno Day.

Although there can be no question of the simplicity and convenience of the proposed calendar, in respect of any prospect of its immediate and world-wide adoption we fear it must be classed with those two other great desirables, the 'metric system' and the "longer daylight day." We are not more firmly convinced of the advantages of this and those propositions for simplifying and rendering easier and more pleasant the round of daily life and its duties than we are that to bring about these suggested improvements will take many years of arduous and persistent agitation.

MEDIEVALISM IN MODERN CHEMISTRY.

In the Revue Générale de Chimie Pure et Appliquée, Gustave D. Hinrichs publishes an article in which he criticises severely the return of modern chemistry to medieval ideas—in Hinrichs's opinion, medieval error.

While one cannot but regret the intensely acrid tone in which the author writes, and the almost directly personal character of some of his remarks, one is forced to admit that there is some justification for his criticism. At the same time Hinrichs's article draws attention to some really very interesting parallelisms between the ultra-modern conceptions of chemistry and certain dicta of the ancient alchemists. Thus he quotes from Berthelot's work 'Les Origines de l'Alchimie" (1885), the following passages: "According to the view of the alchemists, lead was the parent of the other metals. From it were produced the three metals copper, tin, and iron."

"From lead also silver was made. This idea must have seemed quite natural to the ancient alchemists, who recovered silver from argentiferous lead by cupellation."

Again, in his work "Archéologie et Histoire des Sciences" (1906), Berthelot quotes from Chinese writings:

"There are some who say that fan che absorbs the vapors of green yang (orpiment), giving rise to a mineral, called hong che, which in the course of two hundred years becomes converted into native cinnabar. After two hundred years more this cinnabar changes into silver, and this after the lapse of another two hundred years, [illegible]

Great Britain [illegible] this the statement [illegible] Association for the Advanc[illegible]

"Helium is the gaseous product of [illegible] tion."

And again:

"In the presence of water neon is produced, [illegible] is changed into lithium."

And, more particularly with reference to the passage quoted above from a Chinese author, note the following résumé of the modern doctrine, as expounded for example by Arrhenius in his book, "Theorien [illegible] Chemie."

The transmutation of radium comprises the following series of steps:

I. Radium undergoes gradual disintegration. In 1,300 years it is reduced to one-half its original amount, giving rise to

II (a). An emanation, which in the course of 4 days produces

(b). Radium A, which in turn splits up, in [illegible] minutes, with formation of

(c). Radium B, this again, in 21 minutes forms

(d). Radium C; in 28 minutes this latter gives

III (e). Radium D. The substances radium A, B, C, D are solids, and are transformed in 40 years into

(f). Radium E. This in 6 days generates

(g). Radium F, probably identical with polonium. In 143 days this decomposes into

(h). An inactive substance, of which it is unknown whether it is subject to any further transformation.

In the same work the time required for the transmutation of uranium into radium is given as 2,500 million years. This gives for the entire series of transformations 2,500,001,300 years, 152 days and 54 minutes.

Hinrichs here criticises the spurious appearance of great exactitude which is given by this statement, to the minute of a period embracing millions of years. In point of fact this criticism is based on a peculiar misunderstanding, for while we may know a period of six minutes, say, correctly to the minute, the statement of the longer periods obviously cannot be accurate to nearly such a small interval of time, and there is evidently no justification for adding together, as Hinrichs does, the successive periods in order to obtain the aggregate period. For the lesser intervals fall far within the range of the error in the estimation of the long period of 2,500 million years, and are simply negligible in comparison with it.

As for Ramsay's statement with regard to the transmutation of copper into lithium, attention is justly drawn to the recent experiments of Madame Curie, which seem to conclusively refute Ramsay's views. For Madame Curie has shown that if the work is carried out with scrupulous care, in platinum vessels (instead of quartz, as used by Ramsay), there is no sign of any "production" of lithium. Hartley also has shown that both quartz and copper, and in fact practically all minerals, contain lithium.

Hinrichs's paper contains many other criticisms, some of which appear, perhaps, hardly justified. We have selected for presentation here only some of the most valuable and interesting suggestions in an article written in a destructive rather than constructive spirit.

KEEPING MILK BY CHILLING IT.

One method of keeping milk consists in sterilization by heating to 230 deg. F., but this process changes the flavor of the milk, renders it indigestible and alters its chemical composition. Pasteurization at [illegible] deg. F. and simple boiling at 212 deg. F. are less objectionable, but although the germs of disease are destroyed by these methods other microbes are not destroyed and the milk, consequently, does not keep very long. Freezing is seldom effective because of the difference in the freezing points of the various constituents of the milk, so that when the milk is melted it does not possess its original uniform and homogeneous character. Cooling to a temperature slightly above the freezing point has the advantage of leaving undisturbed the homogeneity, flavor, digestibility and nutritive value of the milk, and when the cooled milk is again warmed to the temperature of the air it is found to have undergone no alteration that can be detected by the microscope or [illegible] or biological tests. Besides, the cooling checks the multiplication of bacteria. The milk should be cooled immediately after it is drawn, or after pasteurization or boiling if these processes are adopted. When the milk is cooled to 35½ deg. F. it may be kept [illegible] days at any temperature lower than [illegible] deg. F.

The annual prize of [illegible] instituted [illegible] pold of Belgium in 1874, will, for the [illegible] awarded for the best work in French, [illegible] lish, German, Italian, Spanish or [illegible] progress of aerial navigation, and [illegible] means for its advancement [illegible]

ENGINEERING.

[illegible] is greatly pleased with the re[illegible] recent practice with heavy coast-defense [illegible] Fort Monroe. Five 12-inch and two 10-inch [illegible] fired at a moving target 30 feet high by 60 [illegible], which was towed past the fort at a speed of [illegible] an hour Twenty-four projectiles were [illegible] in 2½ minutes and 18 hits were made Since a modern battleship is from 400 to 500 feet in length and from 20 to 28 feet in height, it is considered that, had the firing been at a battleship instead of the canvas target, every shot would have found the mark

The science of aeronautics, in addition to rapid recent developments in practice is beginning to co-ordinate the results of tests and reduce them to formulæ A paper by M. D. Drzewiecki in Comptes Rendus gives some rigorous formulæ connecting thrust, carrying power speed, surface, and incidence. The minimum power per weight carried is obtained when the loss due to friction and the passive resistances is one-third of the resistance due to incidence. The author claims that none of his formulæ are based on unproved hypotheses but upon direct experiments under varying conditions

The railroads of the United States have ever been famous for the great size and carrying capacity of their rolling stock Nowhere in the world are such heavy passenger and freight trains hauled as in this country Not long ago a train 3,000 feet long, containing [illegible] cars loaded with 4 451 tons of coal, was hauled from Altoona to Enola, Pa. Trial was made to determine what loads could be moved over the middle division, where the maximum grade has recently been cut down to 0 2 per cent. The train was hauled for 124 miles at an average speed of 17 miles per hour by a single freight locomotive

The loftiest chimney in the world was recently put into service at the large smelting works at Great Falls Mont., where it will serve to carry off the gases from the greater part of the large plant The chimney which is built of brick, is 506 feet in height above the ground It is 50 feet in diameter at the top and increases gradually in diameter to the base. The flue includes a dust chamber in which vertically hung wires serve to take out the dust from the smoke The dust is removed from the wires by shaking mechanism and falls in hoppers in the floor, from which it is loaded into cars in a pit below

We note in a recent copy of Peru To-Day that the survey is shortly to be undertaken for a railroad, which will exert a most important influence on the commercial development of Peru The line will start from the port of Paipa, one of the best harbors on the west coast, and will be carried across the lowest divide to be found in the whole of the Andes range in South America, the summit level being only seven thousand feet above the sea This is less than one-half the elevation of the summit of the two existing trans-Andean railroads in Peru, one of which is 14 436 and the other 14,765 feet above the sea. When the line is built, east-bound freight from the coast of Peru, which must now make the circuit of South America and often go to Liverpool to reach its destination will be carried directly across the mountains to Iquitos, the head of navigation on the Amazon River

Railroad engineers are becoming increasingly alive to the importance of building both track and rolling stock with reference to the heavy centrifugal forces which are brought into play when heavy trains are run at express speed around curves. These stresses are particularly severe in the case of heavy electric locomotives built for use on steam railroads We have always believed that the wreck at Woodlawn near this city was due to a conjunction of low center of gravity in a heavy electrical locomotive, high speed, and insufficient elevation of the outer rail of the curve on which the accident happened. To prevent "nosing" or side oscillation, the New Haven electric locomotives have been provided with end pony trucks, and the New York Central locomotives with four-wheel trucks. In both cases the improvement in the running has been very marked.

As we recently remarked, it has been claimed by good authority that all boiler corrosion is [illegible] to galvanic action A paper recently [illegible] by Mr. G N Huntley before the Society of [illegible] Industry on investigation of the cause of [illegible] in a stand-by boiler seems to prove that sul[illegible] important factor in some cases, which [illegible] with the electrical theory An in[illegible] in the proportion of caustic soda used had no [illegible] blisters were found, especially near the [illegible], which, on being pricked, were found to [illegible] with a fine black powder in suspension. [illegible] sulphate with a slight excess of [illegible], while the boiler water was slightly [illegible] sulphur in the water is [illegible] which attacks the [illegible]

ELECTRICITY

The city engineer of Toronto, Canada, will shortly call for bids for an electrical pumping plant aggregating 12,000 horse-power

A long-distance telephone service with four lines is expected to be opened next year between London Paris, Madrid, Barcelona, and San Sebastian

According to the Times (London) the Canadian Pacific Railway will grant use of its right-of way for a special wire forming the connecting link between the Atlantic and Pacific cables of the proposed all British round-the-world system

A French inventor M Gabet, has recently made successful experiments in the Seine with a torpedo which he can start stop and steer electrically by wireless apparatus on land or in a boat He expects eventually to control the torpedo for a range of eight miles

Tests are being made at Brant Rock Mass of the apparatus to be installed at the 1 000-foot tower to be erected at Washington The Navy Department specifications require that it shall be sufficiently strong to send messages 3 000 miles and receive them from the same distance

Electrification of the Grand Trunk Pacific Railway from the St Lawrence River to Monckton is being considered A water-power site capable of generating upward of 100 000 horse-power greatly in excess of the requirements has been selected at Grand Falls on the St Johns River nearly equidistant from the two points between which electrification is proposed

Among interesting papers read before the Royal Society in London recently was one by C Russ upon the electrical reactions of certain bacteria as applied to the detection of tubercle bacilli in urine by means of an electric current Another by Prof H A Wilson described his experiments to determine the effect of a magnetic field surrounding it upon the electrical conductivity of a flame

A patent recently granted to Mr A F Rietzel is expected to overcome the difficulty often encountered in electric welding due to the arc jumping at the nearest points of two not quite smooth surfaces and the exact position of the weld not being easily controlled Raised portions on both sheets to be welded are placed in contact with each other and the welding temperature reached only at the points desired with a result similar to riveting a saving of electrical energy and elimination of burning of metal resulting

The Electrical World calls attention to the great superiority of the electric to the gasoline automobile for city use with especial reference to the anti noise campaign The distracting noise of the latter is sufficiently familiar—to an invalid confined to the city for instance—the occasional startling explosion in the muffler of a charge which has missed fire the screech of changing gears, not to mention the smell None of those disadvantages apply to the electric vehicle which also avoids the opprobrium directed against reckless driving the *electric motor being equally applicable* to a light runabout which a woman or child can operate or to a heavy commercial truck

The generation of electricity by aermotors or 'wind turbines, as they call them is making great progress in England, as shown by an exhibit at the seventieth annual show of the Royal Agricultural Society at Gloucester The exhibit included a 24 foot turbine on a 60-foot steel tower driving a variable-speed generator with considerable excess storage-battery capacity to provide for calms. Current was supplied for an electric grill, kettles, irons and fans as well as a butter churn a cream separator a circular saw, and a deep-well pump By division of the storage battery into two parts it is possible to use 50-volt current for driving the machines and 25-volt current for lighting, the latter permitting the use of metallic-filament lamps.

An interesting article by a lady contributor to the London Electrical Review describes the lighting of an eight-room suburban English home at a cost of $18 75 a year which is further reduced by saving made in other directions over coal and gas for heating and other purposes. The parlor and dining room have two and one 50-candle-power lights respectively costing 6 cents each for 16 hours' service, as compared with 7½ cents each for incandescent gas burners of lower power for the same time The life of curtains, draperies, and plants in the rooms is said to have been twice as long as under the previous gas *régime*, a saving of 12 cents a week for cut flowers alone having been made. Painting and papering had to be renewed only once in four years with electric light as compared with every two years with gas, a saving of two dollars per room per year Electric heaters in the living rooms cost 24 cents per 12 hours each at maximum capacity, which can be reduced when the rooms are warm enough, against 28 cents for gas fires or 12 cents for coal fires, comparing favorably even with the latter when the elimination of cost of cleaning [illegible] is considered.

AERONAUTICS.

A new use for balloons is proposed by W B. Boyce of Chicago who sailed recently for East Africa in pursuit of natives and big game which he will hunt not with the rifle but the camera. His idea is to attract wild animals in their native haunts by a light suspended from a balloon and photograph them in such natural surroundings by flashlight

Authority has been given by the War Office for the leasing of certain ground near Washington for use as a training ground for officers of the United States army in the use of flying machines The first officers selected for instruction will be trained by the brothers Wright personally and they in turn will teach others. A level tract of 163 acres almost free from trees has been chosen so that the practice of beginners may be made at a height of 20 feet or less from the ground, eliminating as far as possible the danger of serious accident

On the 6th instant Glenn H Curtiss who since his 52½ minute flight at Mineola, L I on July 17th is the record holder of the SCIENTIFIC AMERICAN Trophy, sailed for France with a new and untried biplane similar to that which he sold to the Aeronautic Society Mr Curtiss will be America's sole representative in the international aeroplane race for the Bennett trophy at Rheims on August 29th and he will also compete in several of the other contests to be held during the week of August 22nd above the plains of Betheny in the champagne country

Messrs Baldwin and McCurdy, the two Canadian engineers who were formerly associated with Dr Bell are carrying on experiments at the Petawawa Military Camp which is about 100 miles from Ottawa Canada On August 2nd they tried a new 40 horse-power motor on the Silver Dart the last aeroplane of the Aerial Experiment Association After making several excellent flights of half a mile each with both men on board the rays of the rising sun dazzled the aviator so that he steered down too soon struck a knoll and damaged the machine This is the first time on record that the Silver Dart' has carried a passenger The speed attained is said to have been over 40 miles an hour The motor has been placed in a new biplane built for the Canadian government and known as Baddeck No 1' If the flights with this are successful it will probably be taken to England and demonstrated for the British War Office According to the Minister of War $300 000 will be spent during the next year for aeronautics in the army

The Aeronautic Society's aeroplane which was badly smashed on the 18th ultimo when a member Mr Alex Williams was taking his first lesson has been repaired again and tried by Mr Curtiss preliminary to his sailing Mr C F Willard who had made one short flight before the machine was damaged is taking advantage of all quiet mornings and evenings to make practice flights As soon as he has become proficient he will make exhibition flights in various parts of the country At the Society's meeting on August 5th Mr Jose De Viñes gave an interesting talk on model aeroplanes He exhibited and flew several novel toys which he recently brought over from France He expressed surprise at the slowness of America in catching the aviation craze In Paris the children are all building and flying models from which as he demonstrated from small paper models made on the spot much can be learned It was a toy French flyer it will be remembered that first aroused interest in the Wright brothers

The international aeronautical exhibition at Frankfort-on the-Main Germany was opened a month ago, but nothing startling happened until the arrival of the Zeppelin II airship on July 31st The 220-mile trip from Friedrichshafen on Lake Constance was made in about 11 hours The start was made by moonlight at 3 40 A M and the first 56 miles to Ulm were covered in 1 hour and 39 minutes an average speed of 42¼ miles an hour Then a violent head wind sprang up and 5 hours was consumed in covering the next 68 miles. Near Geislingen no headway was made for 25 minutes. The machinery worked perfectly throughout the trip, and the landing was made on a selected spot amid the plaudits of thousands On July 28th at Friedrichshafen a severe test was made in which the airship rose to a height of 1000 feet in a thunderstorm On August 2nd a trip to Cologne 110 miles distant, was attempted When within 30 miles of that city a severe wind and hail storm was encountered and the airship retraced its course at a faster rate than such a vessel has ever traveled before A broken propeller the following day put an end to the second attempt immediately At 4 40 A. M August 5th however another start was made and at 10 15 the airship appeared at Cologne and circled the spire of the cathedral The trip took two hours longer than expected on account of fog A landing was made in the suburb of Bickendorf The same day the "Gross II" made a round trip from Berlin to Halle (217 miles) in 15 hours and 40 minutes an average of 13.85 miles an hour

SOME ACOUSTIC EXPERIMENTS.

BY [illegible] COSTA RICA STATE COLLEGE

Tyndall has shown that ordinary fabrics are permeable to sound as long as they are dry but lose that property when they are soaked with water The quickest way to make the experiment is to submerge one half of a bed sheet in water and then interpose it between the ear and a watch held close by as shown in the illustration The tick tack is easily heard through the dry part of the sheet but the wet region intercepts the sound If both ear and watch are placed on one and the same side of the sheet the contrary takes place the wet sheet reflects the sound which becomes distinctly louder than when the watch is held close to the dry part of the fabric Advantage may be taken of this fact to repeat without apparatus a classical and pretty experiment usually made with two large concave mirrors

Two umbrellas are thoroughly moistened and laid horizontally some 15 to 20 feet apart with the two rods in alinement This last condition which is essential is easily fulfilled by laying the umbrellas as shown with the point of the rod resting on the back of a chair while the handle is loosely tied to a vertical stick stuck into the ground The chair may be moved laterally the handle may be run vertically along its support the umbrella rod may thereby be set at any desired angle A white thread is stretched between the two umbrellas and the rods are set parallel to the thread This is then cut and removed

If now two experimenters (one for each umbrella) place either mouth or ear in contact with the rod and at from two to three inches from the sliding sleeve any word uttered in a low tone in the direction of the umbrella will be distinctly heard in the other umbrella The voice however will not seem to come from the direction of the speaker but from the opposite side that is it will be perceived by the hearer as if the words were uttered in the hollow of his own umbrella by some invisible being Moreover a third experimenter placed between the other two but somewhat outside the straight line uniting the two umbrella rods will not understand a word of the conversation thus carried on though he is but half as far from the speaker as the hearer is

Owing to the large size of the reflectors the experiment is always successful but if it lasts more than a few minutes care should be taken to sprinkle water over the umbrellas from time to time

My friend Prof Tristán who takes much interest in the teaching of science in common schools has found another and still easier way of performing the same experiment A watch is held about two inches above a common soup plate which reflects the sound waves and decreases their divergence Another soup plate kept close to the ear at an angle of 45 deg with the direction of the sound waves causes them to converge into the ear The loud tick tack does not seem to come from the watch but from the plate kept close to the ear It ceases when the two plates are withdrawn

* * *

At the International Congress of Applied Chemistry held in London recently Mr Samuel R Tucker presented a paper dealing with "The Relative Efficiency of the Arc and Resistance Furnace for the Manufacture of Calcium Carbide" Calcium carbide was prepared in two types of furnaces under conditions which would give the best yield Comparison was made of the product as to its carbide content and its weight obtained per energy unit The results showed that for the scale on which the experiments were conducted the resistance furnace was much superior to the arc The best result obtained with the arc furnace was 1 170 watt hours per 100 grammes of pure carbide while with the resistance furnace the same quantity of pure carbide was obtained with 544 watt hours The best proportions of lime and coke to be used with the two types of electric furnace employed were also given

ASKING THE TREE TO SPEAK.

BY CHARLES E. COOKE

Under our system of land surveys the country is being divided into square miles These divisions are known as sections, and along the lines marking them are established corners at half mile intervals The method of marking these section lines varies slightly according to the nature of the country over which the survey is made but in a majority of cases a rock of the dimensions prescribed by law is placed in the ground at each corner and is known as a corner stone When these section lines are surveyed through timber it is required also that trees in close proximity to the corner should be marked giving the township range and section which that particular corner represents These are termed bearing trees and are to aid in the subsequent relocation of the corner stone in the event that it is ever destroyed or removed Furthermore it is required that trees along the line of survey should be marked This is accomplished by chopping off a small portion of the bark on two sides of such trees as are close to the line This is known as the blazed line and if well marked can be easily followed even many years after the original work is done. Once on the line, the task of finding the corner stone is simplified, and unless every vestige of it has disappeared, together with the bearing trees relating to it, one is pretty sure to find it However, in a great many instances these blazed lines are hard to identify, so many years have elapsed since the blazing was done that the bark has completely grown over, or forest fires may have so injured the trees that only here and there one remains to show where the line has been Then, again nearby lines that have been blazed for other purposes are confusing and oftentimes one follows them up only to find them terminating at some point in which he has no interest

A SECTION CHOPPED FROM PINE TREE

Showing original blaze and twenty five years growth since

The accompanying illustration shows how, in this latter contingency the line one is looking for may be distinguished from others provided the year in which the survey was made is known It represents a section chopped from a pine tree and shows the original blaze and the growth of the tree since

During the past year while hunting for section corners in Colorado which had been established in 1883, great difficulty was encountered in locating the proper lines owing to the presence of numerous other blazed lines to mining claim corners prospects etc In order to determine whether or not a certain line was the correct one a section would be chopped out of one of the blazes and the rings appearing in it counted between the blazed scar and the bark Allowing one year's growth of the tree for each ring found it was readily determined whether or not the years which had elapsed since the blazing had been done corresponded with the number of years since the survey looked for had been made In this way it was possible to locate the section lines and once on them, little trouble was experienced in finding the corners

The section seen in the illustration was cut from a tree along the line of survey sought and shows twenty-five rings which growth identifies the work as having been executed in 1883

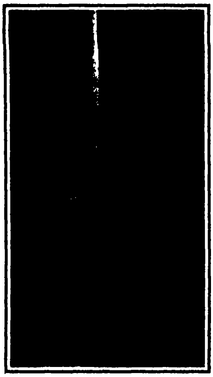
* * *

The Visibility of Stars in Daylight.

The blue light of the sky which prevents us from seeing the stars in the day time is strongly polarised According to the experiments of Cornu the proportion of polarized light may amount to eighty per cent when the air is very clear The light of the stars on the other hand is not polarized. If the polarized light of the sky is cut off by a Nicol prism it is evident that the apparent brightness of the star will be increased in respect to the brightness of the sky Hence the star will become more visible and an ordinarily invisible star may be seen

This method would be particularly advantageous for the observation of circumpolar stars These stars are situated at an average angular distance of 90 degrees from the sun and are, therefore in the best conditions for observation as the proportion of polarized light is a maximum at this angular distance Furthermore one of the two meridian passages always occurs in daytime and the observation of both passages is of great astronomical importance. It is singular that this very simple method which has been suggested by Salet is not employed in these observations Salet shows that by this use of the Nicol the power of a telescope may sometimes be made equal to that of an instrument of twice its aperture without a Nicol Consequently the value of meridian observations, especially in determining latitude may be greatly increased Long ago, Arago proposed to use a tourmaline in order to perceive reefs in a calm sea amid the glare of reflected light, by which they are masked Hagenbach suggested a similar process for eliminating the bluish haze which veils objects near the horizon. Salet, who recalls these facts in the Bulletin Astronomique, states that the employment of the Nicol prism in astronomical observations by daylight has not hitherto been practiced [illegible]

Soup plates as sound reflectors.



The wet cloth intercepts the sound

The man between the talkers cannot hear the conversation.

SOME ACOUSTIC EXPERIMENTS.

MARVELOUS PAINTINGS OF NATURE.

By Dr. Alfred Gradenwitz.

THE novel scope of Nature's artistic work was recently revealed by the marvelous decorative patterns exhibited at the annual show of the French Physical Society The photographs accompanying this article give only a faint idea of their splendor and delicacy of shading. So far from being drawn by the hand of a skilled and imaginative artist, these patterns had been created by Nature in Prof. St. Leduc's physical laboratory at Nantes.

As our readers will doubtless recall from previous articles, Prof Leduc has been engaged for many years in investigating what is called osmotic pressure, or the force of diffusion. This force, with which lay people are relatively unfamiliar, plays an all important part in connection with vital phenomena. It drives the humors of plants and animals through their vessels and pores. According to the views held by the French experimenter, it even determines the forms of vegetable growth In fact, Leduc has succeeded in producing by simple diffusion experiments the most varied artificial plants, of which we illustrate some particularly beautiful recent samples.

The decorative patterns forming the main subject of the present article are indebted for their existence to the same force of nature which manifests itself wherever solutions of different concentration are separated by a porous partition, bringing about a motion of liquid, until a perfect equality of concentration is produced.

The following particulars will enable any amateur to obtain these figures of diffusion On a glass plate are poured out five cubic centimeters of a 10 per cent gelatine solution to which has been added a drop of a saturated solution of different composition (preferably ammonium chloride, bromide, or iodide) On the gelatine thus prepared are arranged symmetrically drops of various solutions, such as calcium nitrate silver nitrate, potassium citrate If this plate be allowed to rest on a horizontal surface the liquid drops are seen to diffuse gradually, generating the most surprising affects of form and color Care should be taken to protect the plate when drying against any shock The resultant picture is glued on pasteboard, like a photographic print, for use as a decorative pattern

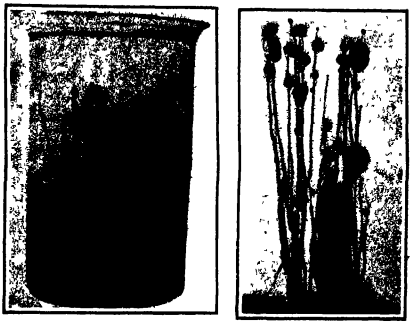
Certain substances will produce by their diffusion lines of equal distance, alternately transparent and opaque, the thickness of which lines varies from some tenths to less than 1/1,000 of a millimeter If their thickness is between 1/100 and 1/1 000 millimeter the patterns are full of networks of lines, and rectilinear or circular gratings, giving the most splendidly colored diffraction spectra

These gratings are obtained with a large number of substances. Very beautiful samples are produced by allowing a mixture of saturated solutions of potassium phosphate and carbonate in equal parts to diffuse In fact, the effects thus obtained are quite similar to the scintillation of mother-of pearl.

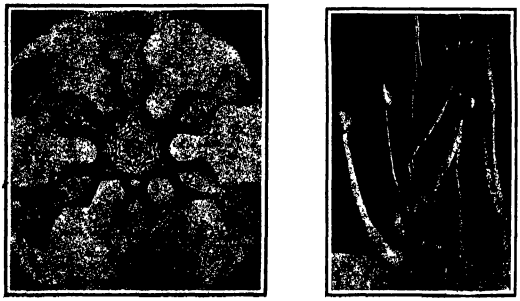
As Leduc points out, all living tissues show the same network structure. In fact, not only in mother-of pearl but in the wings of beetles, feathers of birds, muscles and sinews of man, and in many other living substances, the same structure and color effects whose production no physical force so far sufficed to explain may be observed

In addition to its scientific interest the process above described is obviously of the highest practical importance It renders it possible to reproduce the most delicate photographs by coating the gelatine of the photographic plate at 35 deg C with a gelatine layer, containing traces of calcium nitrate on which drops of a mixture of calcium phosphate and carbonate are spread out

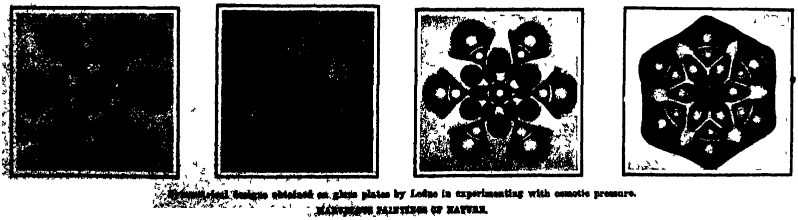
In order fully to account for those strange phenomena, the hypothesis should be made that diffusion occurs not continually but periodically at given intervals of time



Plant-like forms obtained in Leduc's experiments with osmotic pressure



Other forms of plant-like structure obtained by Leduc



Symmetrical designs obtained on glass plates by Leduc in experimenting with osmotic pressure.

MARVELOUS PAINTINGS OF NATURE.

* * *

Dentists have made the startling disclosure that they can alter and enlarge the jaws in any child by simple means, and they have found that the teeth themselves and their arrangement are the pattern from which the jaw takes its shape Three people out of four seem to lack in the proper development of the lower portion of the face by reason of defective and misplaced teeth and weak and ill-developed jaws. Hence we deduce that the 'man of destiny" the man with firm jaw who knows his own mind" is presumably one who was made to chew properly in childhood, and was not allowed to shove down his food half chewed or unchewed by gulps of liquid —Popular Science Monthly

* * *

Kieselguhr

Kieselguhr is a variety of infusorial earth, which is used as a filler for soap sealing wax paints, and other products and employed in the manufacture of dynamite, alizarine soluble glass, cements, artificial stone articles of gutta percha and India rubber, and for many other purposes

Kieselguhr is found in large quantities in Hanover where it occurs in gray brown or pale green layers in alluvial deposits and near beds of lignite It is soft and dry to the touch absorbs water very readily and is not affected by chemical reagents at ordinary temperatures Kieselguhr is found also in Hesse, Hungary Bohemia Tuscany Sweden Finland, and Canada.

The valuable properties of kieselguhr are its low specific gravity (0 25 to 0 55) its great power of absorbing water and its low thermal conductivity, which make it one of the best known heat insulators.

It is extracted from open pits spread on planks on the ground, and left to dry under the action of the sun and the wind Artificial desiccation has not proved practically successful, according to a report of the American consul at Hamburg Drying in ovens presents no difficulty but also no particular advantage and has never been attempted on a large scale (Kieselguhr is quickly calcined by contact with flame.) Various mechanical drying processes have been tried and abandoned in Germany Drying by a blast of hot air has been employed to some extent but only in wet seasons or after partial drying in the usual way The method is too expensive for use except for the best grade of kieselguhr which is employed in making dynamite and when the market price is unusually high

Kieselguhr as it is taken from the pit, contains from 70 to 90 per cent of water which evaporates very slowly Air-dried kieselguhr retains from 15 to 25 per cent of water The dried kieselguhr is ground and packed in bags During transportation and storage it must be carefully protected from dampness.—Cosmos

HALLEY'S COMET

BY DR. ALEXANDER W. ROBERTS.

Already in the pages of this magazine reference has been made to the approach of Halley's comet the most important astronomical event of the years 1909 and 1910 Every seventy five or seventy-six years this remarkable body completes its far-stretching and extremely elliptical orbit round the sun

When the comet sweeps round the sun at its nearest approach or perihelion, it passes within the earth's orbit while at its farthest reach or aphelion it lies outside the confines of the solar system Thus during the greater part of its long journey for at least seventy three years out of the seventy five or seventy six, it is invisible in even the most powerful telescopes It is then describing that portion of its path which lies outside the orbit of Jupiter When however it is within the orbit of this planet it is near enough to our earth to be visible in our evening or morning skies

At first on its sunward flight it is discernible only as a faint telescopic object but each day witnesses its increase in brightness till at length it is visible to the naked eye is indeed conspicuous enough to compel the gaze of even the indifferent beholder As a rule it is easily seen by the unaided eye for some months

After passing its brightest phase—which it will do this cycle in the first week in June 1910—it rapidly decreases in brightness and is soon lost to view in even the largest telescopes

It was last seen at the Cape Observatory in May 1836, passing after that date into the far distances from which it came But although it vanished from the sight of men its onward track through space was known with as great accuracy relatively as sailors know the way of a ship over the trackless deep And thus every lap of its vast orbit over three thousand million miles distant at its widest reach from our earth has been mapped out with the utmost care and with assurance Unseen for seventy three years, it is yet as surely seen by those who make this branch of astronomy their care as if it shone brightly and continuously in our midnight sky The invisible bonds of law have it in their inexorable hold and from out the confines of that unbreakable leash it can never never pass

In the accompanying figure are given positions of the comet at various dates along the 1835-1910 cycle

We have already said that the comet was last seen in May 1836 It was then moving swiftly away from the sun midway between the orbits of Mars and Jupiter In the early days of 1837 it crossed the orbit of Jupiter Jupiter himself was not very far away when the comet passed under his line of march Slowing now down considerably the year 1838 is well advanced before the region of Saturn's away is reached In six more years Halley's comet is as far distant as Uranus and in twenty more years it is out beyond the farthest planet And now like a great stately ship wearing in midocean the comet slowly sweeps round in its orbit Its long outward flight is spent and the conquering homeward pull draws it sunward again The year 1872 marked the comet's farthest distance its aphelion after this date its return journey begins

At the opening of this century it was again within the orbit of Uranus By the end of 1907 it had reached Saturn's orbit and early this year it swept within the orbit of Jupiter

On the first of June this year it was five hundred million miles distant from us but rushing in at an ever increasing speed In June its velocity of approach was a million miles a day

It will come nearest to our earth the first week of June 1910 being then only twenty million miles distant from us a handbreadth in astronomical reckoning

After this date it will move swiftly away from the earth becoming daily more faint till in the early days of 1911 it will disappear into the night not to emerge again till the year 1985 when the most of those who read the article will have ceased to care about comets

No small emulation is being witnessed between those observatories endowed with large telescopes as to which one will be the first to pick up the returning voyager from far-distant shores It is expected that this will be done in August or September of this year The comet will then be a faint nebulous star not far from Orion But with regard to this matter of search it may be said that it has already begun chiefly by means of photography it being thought that this auxiliary to science might make visible fainter objects than the eye can see

In July of this year the comet held its course in the morning constellations and was then badly placed for northern observers. It is so well placed, however, for southern observers that there is a hope that some observatory south of the line may have the good fortune to pick up the comet before the lengthening nights will enable northern observatories, armed with huge telescopes, readily to pick it up in the northern autumn From September 1909 to March 1910 the comet will be well situated for observers all over the world, being then high up in the midnight sky

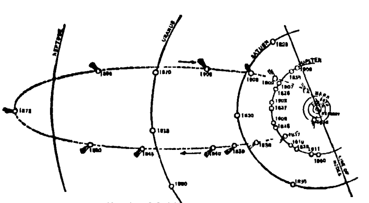
By the month of April, 1910 it will have passed right round to the evening sky, and toward the end of the month it will be lost in the rays of the sun. During May it is for a brief time a morning star but in June it has again stolen round to the west and should in that month be an object of conspicuous brightness in the evening sky of southern latitudes. It will remain an evening star till October of that year when once more it will pass behind the sun and then will appear as a morning star By this time however it will be rapidly decreasing in brightness and will soon be lost to view

There are few more interesting chapters in the history of astronomical research than that which tells the tale of the tracing back through the long centuries of this remarkable comet Chiefly through the devoted labors of a group of classical and Oriental scholars we can trace back the appearances of Halley's comet through twenty centuries surely a long enough period to give it a distinction among comets

Some of these appearances are of unique interest On the Bayeux tapestry there is a famous picture of the comet which appeared in 1066 and which William the Conqueror regarded as a herald of victory for his arms Hind proved that this fateful star was none other than Halley's comet

Then again there are many references in classical literature to the appearance of various 'fearful stars some of which can be claimed as returns of Halley's comet

It is a marvel that the deductive minds of many of the ancient philosophers did not see a connection—as they did in eclipses between regularly recurring phenomena. Possibly the fear which these supposed messengers of doom raised in the hearts of all, learned or unlearned may have led the ancients to leave comets alone



HALLEYS COMET DURING CYCLE 1835 1910
Note The places given are for January 1 of the dates indicated

It is to Edmund Halley the contemporary and friend of Newton that we are indebted for lifting comets from the region of superstition to the calmer sphere of pure geometry At Newton's request he undertook a thorough investigation of their movements and into the laws which controlled these movements The 1682 comet especially held his attention His keen mind soon traced a connection between similar appearances separated by seventy six years and on working out the orbit of the comet which will now forever be inseparably connected with his name he boldly declared that it would again appear in 1758 It was seen for the first time on December 25th of that year by an amateur astronomer in Saxony

Thus for ever the mystery which had gathered round comets was dispelled

There are one or two very interesting questions connected with the return of this comet Of these one is the constitution of these bodies The usually accepted view is that they are composed of myriads of meteors at a very high temperature But this does not explain their appearance thoroughly It is indeed rather an imperfect explanation of the tail

Then do comets grow fainter each return? The belief prevails that they do A comparison of the forthcoming appearance of Halley's comet in 1910 with the magnificent drawings made by Sir John Herschel of the 1835 appearance should do much to settle this question

It is said that there are planets exterior to Neptune Dr See of Mare Island Observatory has even given them a local habitation and a name If there are extra Neptunian planets, then they should make their presence felt by perturbations of such comets as pass out beyond the orbit of Neptune We have already referred to the near approach of Jupiter to Halley's comet in [illegible]. This approach would have the effect of pulling the comet back in its orbit, and then by decreasing its centrifugal force bring it back more quickly again to the sun. Every planet circling round the sun tugs at the comet more or less, now hastening, now retarding its journey Because of such "interferences" its path round the sun is a sinuous curve, and sometimes because of hindrances by the way, it takes seventy-seven years to return, while at other times it is incontinently pushed onward and its round is seventy-five years.

Thus if there are planets beyond Neptune they will make their presence felt in disturbing the comet as it passes its aphelion goal.

Enough has been said to indicate how much interest attaches to the appearance of this comet in 1910, and how eagerly its coming is being watched and waited for

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Status of the Birkeland-Eyde Nitrogen Reducing System.

It may be of interest to present some of the leading points regarding the present state of the nitrate industry in Norway, using the Birkeland and Eyde electric arc furnace. In this process, the gases coming from the furnace are rapidly cooled so as to prevent a decomposition due to the heat. In this way the yield is increased Since 1905, when the first plant was started at Nottoden Mr Birkeland has been making researches with a new tubular furnace On the other hand, the Baden Aniline and Soda Works, of Ludwigshafen which is associated with the Norwegian enterprise is also studying a new type of tubular arc furnace but without the use of a magnetic field for blowing the arc It appears to give satisfaction and will soon be used experimentally in Norway The question of fixing the nitrous vapors industrially has given rise to many researches At Nottoden, the processes are kept secret as much as possible, however The gas coming from the furnace is taken to oxidizing towers, where they remain for a certain time and in this part the nitric oxide is finally transformed to nitrogen peroxide. The latter is passed into large granite towers of 35 square yards section and 60 feet height and the gas is acted upon by a water spray Nitric acid of 25 per cent strength is thus formed and this can be used for preparing the nitrate of lime, which is used as a fertilizer There remains 20 per cent of nitrogen peroxide in the gas coming from the towers, and it is passed into wood towers resembling the former and is there acted upon by the alkaline solution such as carbonate of soda or lime water After this treatment the gases do not contain more than 3 to 5 per cent of the peroxide The preceding products allow of obtaining nitrate of lime by neutralizing the nitric acid by roughly broken limestone, and the bath is evaporated by the waste heat of the furnace The nitrate of lime for chemical purposes is delivered in blocks, while for agricultural purposes it is crushed and sifted On the other hand the treatment in the towers by the carbonate of soda solution yields nitrite and nitrate of soda The pure nitric acid coming from nitrogen in this way gives rise to products which are of value for pyrotechnics as it is found that the impurities in the industrial products often cause changes in the material and these give rise to accidents. The present acid is almost entirely pure and so is well adapted for this purpose As to the value of Norwegian nitrate for fertilizing H De Feilitzen finds that for oats the yield per acre is greatly increased Without fertilizer we have the figure 4 2, with natural Chile nitrate it is 6 1, and with Norway nitrate it reaches 7.1 It is probable that 200,000 tons of Norway nitrate will be produced in 1913 and 125,000 tons in 1911.

◆

Grinding Cement

Fineness of grain is greatly to be desired, both in finished cement and in the raw materials of which it is made In the new Pfeiffer cement machine the process of grinding is kept separate from the expulsion of the meal, or product of grinding. The last-named operation is effected by means of a fanning mill of peculiar construction which, without employing any sieves, delivers a product of very fine grain. The machine requires much less power than the ordinary machine so that a very fine cement can be produced more cheaply than common cement is produced by the usual methods.

◆

It is gratifying to learn that the application of block signaling on the railways of the United States is increasing, although not very rapidly The last report of the Interstate Commerce Commission shows that the total length of road operated under the block system at the beginning of the year was [illegible] miles, a net increase over the previous year of [illegible]. This small increase is attributed to the financial [illegible]

THE WIESEN VIADUCT.

BY OUR PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

One piece of railroad construction in Switzerland which presents considerable interest is the great Wiesen viaduct, which has been building for some time past. The viaduct's central span is one of the longest as well as the highest to be found in the country

The present viaduct forms part of a new section of railroad of short length which has been undertaken within a recent period in the region lying in the eastern part of the country The line belongs to an extensive system of railroads known as the Rhätische Bahn, and it is designed to give a long needed passage through the picturesque Davos-Landwasser valley for up to the present the valley has been traversed only by an ordinary road Hereafter the well known mountain resort of Davos will have a direct connection with the region lying to the south The line thus gives an outlet to the center of the Graubunden canton, and passengers can easily reach the different parts of the Engadine region by rail The new railroad section will thus be a great advantage for Davos, so that the resort which is already much frequented will have a still greater development after the railroad line is finished. Connection is now made with the Abula railroad, which is another of the Swiss lines recently built in this region

Work on the construction of the new line, known as the Davos-Filisur route is actively under way at the present time The railroad is of short length like many of the mountain lines in Switzerland for it is scarcely over 11 miles long Still it presents many interesting features. A gage of 1 meter (39 37 inches) is employed in this case Davos the starting point of the line lies at an altitude of 5 019 feet above sea level, while the southern terminal at the locality of Filisur has an altitude of 3 521 feet, so that the gradients on the section are considerable The maximum gradient is 35 per cent and the minimum radius of the curves 380 feet. The track is laid upon steel ties. Following along the valley of the Landwasser which after Schmelzboden narrows to a deep gorge lying between high rock walls the route is one which tourists will find agreeable for its picturesque character On the section between the above locality and Wiesen a considerable amount of work has been done in the way of tunneling and building viaducts In all, there are six tunnels, the longest of which is the Silberberg tunnel In its construction springs were met with which gave some difficulty After crossing the mountain torrent of Monstein, the line reaches the locality of Wiesen near which is situated the great viaduct, lying between Wiesen and Filisur The main central span lying over the Landwasser stream is 182 feet, and the height of the arch above the level of the stream is about 300 feet. It was difficult to obtain suitable building stone in the region Concrete was used for the main body of the work and hewn granite for the facing At the top of the arch the width is 126 feet and at the base the width is 165 feet The thickness at the summit is 6 0 feet and at the bottom 10 feet for the masonry On each side of the main arch there are two arches of smaller size having 65-foot span and lying at the same height above the level of the stream In order to carry out the work of building the principal arch there was thrown across the stream between abutments an iron trelliswork bridge of 3 feet width which was held upon two suspension cables these latter being anchored at either end The viaduct is built according to the designs of M Hans Studer, one of the leading engineers of the road

The Current Supplement.

Thanks to the speed of modern steamers and the development of the railroad system in India, the base of the Himalayas is now only twenty days' journey from Mediterranean ports. Hence mountain climbers who wish to distinguish themselves by lofty ascents or explorations have undertaken summer expeditions in the high mountains in northern India. In the first rank of these explorers stand Dr and Mrs Bullock Workman, who since 1898 have made five expeditions in the Himalayas Their latest exploits are recounted in the opening article of the current SUPPLEMENT, No 1754. D. Geyer contributes much curious information in an article entitled "Snail Gardens." Dr Reiner Müller writes on the subject of the inheritance of acquired characters in bacteria, and shows how it is possible by artificial means to impress upon a living organism a new and definite character which is hereditary and which remains constant through a vast and indefinite number of generations. An approximately correct idea of the form of our planet is a comparatively recent acquisition of science Dr Bourgeois of the French Equatorial Geodetic Expedition tells us how this new knowledge is obtained The yeast cell and its lessons are taken as the subject of an instructive article by W Stanley Smith. The [illegible] process of cutting metal is a new technical [illegible] authoritatively discussed by E. F. Lake. Maria Parloa's excellent monograph on the canning and preserving of fruit is continued Twenty five years have elapsed since Arrhenius advanced the theory that acids, bases, and salts in aqueous solution are dissociated into their constituent ions Now that the storm of contention aroused by this doctrine is clearing it may not be inappropriate to consider more calmly this proposition of Arrhenius's, to reinspect the foundations and to weigh without prejudice the successes and the failures of the ionic theory This has been done by Gilbert Newton Lewis in a thoughtful article entitled "The Use and Abuse of the Ionic Theory The Engineering Electrical and Trade Notes will also be found as usual

The Glidden Tour

The sixth annual tour of the American Automobile Association better known as the Glidden Tour was completed at Kansas City Mo on the last of July after a more than usually strenuous journey of fifteen running days from Detroit *via* Chicago to Denver and back to Kansas City

It is impossible for us with the space at our disposal to give even an outline of the performances of the various cars or the incidents of the trip but as at least half the space in a number of automobile trade journals have been devoted to such details for three successive weeks it is perhaps hardly necessary

There are however several features of the tour worthy of especial mention even in a non-specialist paper

The roads are agreed by a number of veteran Glidden tourists to have been the worst ever encountered varying from axle-deep sand to mud as deep and perhaps worst axle-deep ruts in hard baked gumbo In several cases the entire crew of a car was thrown out by crossing too swiftly in descending a hill a concealed water bar or similar obstruction grass hummocks and even bowlders grazed axles and under pans and bridges on the prairie roads had to be repaired before safe for passage Considering these difficulties the fact that 8 cars finished with perfect road scores (without losing marks for delay breakage repairs or adjustment *en route*) as many as 21 out of the 32 contesting cars covering the first 810 miles to Minneapolis over perhaps the worst roads encountered without being penalized is strong testimony in favor of the claim that the reliability of American manufacture has reached something like perfection Even the expected spring troubles were conspicuously few

Whereas in former years the Glidden has been considered to be a big car tour small cars having hardly a fair chance to make a showing proportionate to their cost an attempt was made this year in the system of marking and distribution of the trophies to place the smaller cars on equal terms The result however still shows that the best low powered car is hardly equal to so strenuous a journey

Great hospitality was shown to the tourists at practically every town and village passed Detroit Minneapolis and Denver particularly distinguishing themselves and farmers' families lining the route even in remote districts The latter seem to be overcoming their hostility to horseless vehicles not merely making way for the automobile and taking its dust with a better grace but themselves adopting its use to avoid those alternatives The interest shown by the agriculturist in the tour should benefit participants in the latter commercially in these days of high priced grain and promise of abundant crops as well as materially assisting the universally beneficent cause of good roads

The Glidden trophy for the largest cars and the Hower trophy for runabouts were won by Pierce Arrow' cars three of which finished with perfect road scores the two winners actually having no marks deducted for any re-adjustments to be made at the finish to put them in the perfect condition in which they started which is certainly a most remarkable showing

The Detroit prize for intermediate cars was won by a Chalmers-Detroit car two of the three Premier cars entered also finished with perfect scores

A remarkable record was made by a Rapid commercial delivery truck which was sent on the unaccustomed 2 600-mile journey by its enterprising manufacturers carrying over a ton of baggage and accessories for the tourists on solid tires It not only rendered yeoman service but actually would have been unpenalized on several of the worst days' runs had it been competing with the touring cars and climbed Pike's Peak as a diversion during a pause in the tour

BLERIOT'S CHANNEL FLIGHT AND OTHER RECORDS IN FRANCE

We reproduce herewith several photographs showing the start of Bleriot across the English Channel, and also showing him flying above the Channel when beyond sight of land These photographs give an excellent idea of the birdlike appearance of Bleriot's monoplane when in flight. A full description of his record flight and of other records which he has made appeared in our last issue

The extremely rapid progress being made in aviation in France is truly astounding One of the men who has made extraordinary progress is M Roger Sommer His record to date is truly remarkable and shows that when one once learns to fly an aeroplane there is a fascination even greater than that experienced with the automobile During six consecutive days from July 13th to 18th inclusive M Sommer made the following flights July 13th two flights of 15 and 19 minutes On the 14th a flight of 27 minutes at a height of from 10 to 65 feet covering a distance of 12 kilometers (7 5 miles) outside the limits of the aerodrome within 10 minutes On July 17th a 30-minute flight during which 12 liters (3 2 gallons) of gasoline were consumed and on the 18th a flight of 1 hour and 4 minutes On July 27th this time was increased to 1 hour 23 minutes and 30 seconds On August 1st he flew 1 hour 50 minutes and 30 seconds beating all French records Three days later he made a flight of 2 hours and 10 seconds which up to the time of our going to press is the longest record made by a foreign aviator M Gaudart is another beginner who has recently met with considerable success On July 18th at Juvisy he made three circuits of the aerodrome in a gusty wind covering a distance of about 4½ kilometers (2 5 miles) Starting at 3 14 A M on August 7th in the moonlight he made a flight lasting 2 hours 27 minutes and 15 seconds the altitude attained varying from 20 to 90 feet This surpasses the record of 2 hours and 20 minutes made on December 31st last by Wilbur Wright and is an endurance record for an aeroplane

Capt Ferber made several flights on the Champ de Mars on July 18th with his Voisin biplane Two days later he made six successful flights at Belfort after which he shipped his machine to Vichy for the aviation meet On July 19th Henry Farman made a flight of 1 hour and 23 minutes at Chalons The flight started at 8 17 P M and terminated at 9 40 when the gathering darkness obliged Farman to descend His new machine has the tail placed farther apart than the former one and is fitted with runners instead of wheels The balancing planes are placed between the ends of the main plane On July 21st at Chalons Mr Farman took up Mr Cockburn in a new machine which the latter has just purchased It made a circuit of the camp a distance of about 1½ miles

From the above it will be seen that the aeroplane is making great strides in France No less than forty six machines have been entered for the great aviation meeting at Rheims during the week beginning August 22nd and at this meeting aviation abroad will for the first time be put on a sound footing

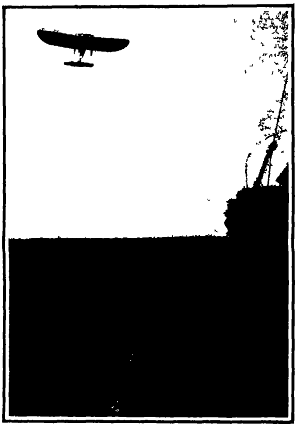
COMPLETION OF THE GOVERNMENT CONTRACT BY ORVILLE WRIGHT AT FORT MYER

With the making of the ten-mile cross-country speed test by Orville Wright at Fort Myer on July 30th as mentioned in our last issue the government requirements for a heavier-than-air flying machine were completely fulfilled The speed averaged by the machine carrying Orville Wright and Lieut Foulois as passenger according to the timing of the officers in charge of the test was 42 58 miles an hour On the outward journey when flying somewhat against the wind the machine averaged 37 735 miles an hour while on the return trip the average speed was 47 431 miles an hour As the bonus offered by the government was $2 500 for each mile per hour in excess of forty without taking into consideration fractions of a mile the Wright brothers received a bonus of $5 000 which made a total of $30 000 for their machine

The more one considers this remarkable flight the more the excellent qualities of the Wright biplane and the daring of Orville Wright in making the cross country flight to Alexandria Va stand out With a somewhat smaller machine than that used last year (the planes are 36 feet long by 6 feet from front to rear) some 1 200 pounds of weight was carried at a speed of 42½ miles an hour with an expenditure of not over 30 horse-power This means that the machine lifted 40 pounds or more per horse-power expended and carried this weight at a faster speed than has ever been shown in an official test by any other aeroplane The weight lifted per square foot of supporting surface however was much less than in the case of Bleriot with his No XII monoplane for the Wright machine carried only about 2¼ pounds to the square foot whereas Bleriot lifted over 5 The speed the latter attained in an official test at Douai France last month was 10 miles per hour less than that reached by the Wright biplane in its test at Fort Myer although Bleriot's monoplane had approximately the same horse-power and lifted practically the same weight A comparison of the two machines shows very neatly therefore the greater lifting power of a single deeply curved surface over superposed slightly curved surfaces and brings out the fact that when such a surface is used, as was the case with the Bleriot machine, speed is sacrificed for lifting power On the other hand however as a practical machine for the use of sportsmen the monoplane of Bleriot offers distinct advantages in the way of small space occupied light weight of the apparatus and ready portability After making his 25-mile cross-country flight from Etampes to Chevilly on July 13th last Bleriot dismounted the wings of his machine fastened them to the sides of the body frame and towed the machine over the road on its three wheels to Paris a distance of 41 miles arriving there by evening The performance of such a feat shows the superior adaptability for war purposes and for all practical uses of the monoplane type of aeroplane mounted on wheels as compared with the biplane type of machine mounted upon runners and requiring a starting rail and dropping weight to launch it

The fulfillment of the specifications of the United States government for a heavier than air flying machine marks an era in the development of aerial navigation When these specifications were issued in December 1907 the Wrights had not demonstrated any of their claims the chief of which was that they had flown for 38 minutes more than two years before Santos Dumont Farman and Delagrange had made little more than jumps and the art of aviation was in its infancy as far as any practical demonstration of what had already been done by the leaders was concerned The specifications issued by the War Department required an endurance flight of one hour with a passenger a cross-country speed test with a passenger for a distance of ten miles in which a speed of not less than 38 miles an hour must be shown and the carrying of sufficient fuel for a 125-mile (3 hour) flight These specifications were so rigorous that even the most hopeful aviators were doubtful whether they could be fulfilled but when Wilbur Wright flew for 2 hours and 20 minutes on December 31st last in France all doubt was dispelled as to whether or not the Wright brothers could fulfill the specifications Nevertheless the best speed shown by the Wright machine in France in the different speed tests there did not exceed 38 miles an hour very much and there was consequently considerable doubt as to how fast the machine could travel and how much bonus Orville Wright would win After making the hazardous trip over several deep valleys and high hills he expressed his belief that had there been no wind to drive him out of his course he would have made 44 miles an hour and received the full bonus The height which he attained in passing over the valleys was 400 to 500 feet When the fact is considered that had the motor stopped both men in the aeroplane would have been in imminent danger of losing their lives from the descent of the machine on the tree tops one can readily see that the making of this flight required more daring than the making of a flight across the English Channel Not only this but two lives were in jeopardy all the time

A glimpse of Bleriot shortly after his start.

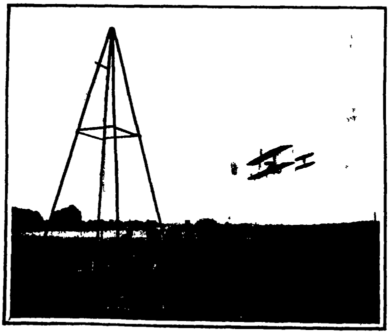

Bleriot in mid-Channel

BLERIOT'S FLIGHT ACROSS THE ENGLISH CHANNEL.

There are several new aviators in France who almost daily are making new records. Chief among these is M. Paulhan, who, with his Voisin biplane fitted with a tail and a Gnome revolving cylinder motor, on July 19th made a cross-country flight from Douai to Arras, a distance of 13 miles. The flight was made in 22 minutes, at an average speed of 35.4 miles an hour Next to Bleriot, M Paulhan holds the record for cross-country flying in France. He also holds the record for height, having flown to a height of 120 meters (393.8 feet), and thereby beaten Wilbur Wright's 110-meter (350-foot) record made on December 18th last at Auvours. Some of M Paulhan's recent records made at Douai are as follows 12 kilometers (7½ miles) in about 15 minutes at a height of 30 meters (98 feet), July 23rd, 1 hour 17 minutes 19 seconds, covering an official measured distance of 48.178 kilometers (30 miles), but actually traversing a distance of 70 kilometers (43.5 miles), when the wide turns are considered

July 18th, M Paulhan raced M Bleriot with the latter's biplane at Douai, over a distance of a kilometer (0.621 mile) in a semi-circle. This was the first time two aeroplanes have engaged in a race and the fact that these were a biplane and a monoplane with two distinctly different types of motors made this race all the more interesting M Bleriot won in the time of 1 09 an average speed of 32.4 miles an hour, while Paulhan's time was 1 37 an average speed of 23 miles an hour The same day M Bleriot won the Prix du Nord by covering 2 kilometers (1.4 miles) in 2 minutes 29 seconds

Although America was the first to secure an aeroplane for the use of its War Department, several other nations are quietly working to develop machines of their own In England, Capt Cody who however has not been aided very much by the government has lately been making successful flights with a biplane nearly twice the size of Wrights' On July 21st he flew 4 miles above Laffan's Plain near Aldershot This is the first biplane according to Capt Cody in which every possible effort has been made to avoid head resistance He believes that his machine has less head resistance than any other so far constructed of the same size and with an engine of about 30 horse-power he has flown successfully at good speed The French government also is experimenting with a biplane but up to the present no attempt has been made to purchase such a machine from any of the numerous constructors. Orville Wright expects to go to Germany very soon, with the idea of selling a number of machines to the German government Italy has already acquired one Wright aeroplane and will probably have several more soon The Austrian and the Russian governments are also interested in aeroplanes for war purposes. Up to the present time however our country and Italy are the only ones which have aeroplanes, and which are ready to purchase more of these machines in the near future It is probable that new specifications in which greater requirements will be made will be issued within a short time by our War Department


A short turn.

The Wright machine in a sunset flight.

THE LAST WRIGHT FLIGHTS AT WASHINGTON.

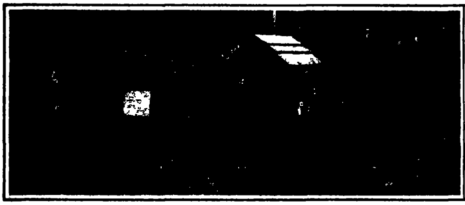
AN AMERICAN FORESTRY SCHOOL.

BY RAY ALLEN WILEY

One of the Eastern States to which forestry is of really vital importance is Pennsylvania, for the reason that such a large revenue has been secured from its timber interests. Only ten million acres of its area has thus far been devoted to agriculture, the lumbering industry being very extensive over the balance of the State on account of the forest growth. In Pennsylvania, as well as other States the lumber industry has been accompanied with great waste owing to the crude methods employed—the large quantity of valuable stumpage being left, young trees broken down in felling larger ones while the practice of skinning" the forests or cutting down the most valuable trees regardless of the destruction to the young growth has in itself caused a great loss.

Students learning packing of animals for mountain transportation under chief packmaster, U. S. Army.

Work with transverse plane table in rapid measurement and sketching of forest types and areas.



Small plants used for teaching principles of treatment of timber with creosote

Forestry students studying structure of commercial timbers and methods of identification

Operations on sample trees in wood-lot to determine average rate of growth for every decade.

A class in silviculture gathering seed of maples in a large sheet

AN AMERICAN FORESTRY SCHOOL.

Several large railroad companies obtain much of their timber from the State especially the Pennsylvania Railroad Company, which has introduced a forestry system on its own lands that has resulted in much practical benefit The most notable movement however, is one which has been taken up by the State authorities in the creation of the only under graduate forest school between Michigan and Maine. The school has been planned on a very broad scale and is intended not only to educate those who attend it in every branch of forestry but to conserve this most important resource so that the timber supply of the State will be permanent.

The institution itself is located in Center County where an excellent opportunity is provided for a study of the various branches but in addition the students are sent to various portions of the State as well as out of Pennsylvania for additional study and practice The State College as it is termed gives special attention to field work in addition to the routine of the class room and lecture room In connection with the earlier courses in forestry the men are taken into the field where they study each kind of tree its form, its bark leaves buds and flowers until they are perfectly familiar with the trees and the material with which they will work Following this they carry on during the fall season the work of collecting the fruit and seeds of various trees and their storage dry in bags or buried in moist sand In the spring the seeds are taken and planted in forest nurseries the students doing the actual work of planting and cultivation Numerous trips are made in the vicinity of the college to study natural reproduction of the forest Near by is a State reserve of several thousand acres and the State Forestry Reservation Commission has given the college an annual privilege of going upon this reserve for study and demonstration in forestry There is no other forest school in the country that has so large a tract of wild land so near at hand and so available for study at all times. Last year one of the advanced classes made a topographical sketch of a large gap in the hills which supplied the college with water, and followed this with a forest map, showing the nature and amount of timber growth and from notes taken in the field worked out a plan for the future management of the watershed

At the State College the course of training includes not only preparation for forestry in the East but forestry in the West As an illustration the students are even instructed in the use of pack animals, which are so much depended upon in the great national forests where the only route may be a pony trail The course of instruction includes the care and use of ponies and mules the methods of loading them also riding Pack trains are fitted out and the students make expeditions as they would in the Rocky Mountain region or on the Pacific coast Two weeks at the end of the junior year are spent in camping upon some large wood lot in the State where the boys get very practical training in camp life in the estimating of timber and its actual measurement by various methods rapid sketching and mapping of forest areas and in study of tree growth by analysis of tree trunks From the data obtained in the field a map is made and a plan drawn up for the correct management of the wood lot There are many locations in Pennsylvania which are admirable for field work because within a small area may be a large number of varieties of trees forming a miscellaneous growth An opportunity is also given the students to investigate the different varieties of soil the extent of the watershed and to obtain other data which will be of great value in connection with their future vocation.

During the last year the members of the graduating class are put through a very rigid test, being required to spend at least four weeks in some forest region either in Pennsylvania or other States. They are sent to a lumber camp where they make a study of lumbering as associated with forestry. This month in the lumber woods is taken as a part of a course in lumbering in which each operation from the log in the tree to the finished product is thoroughly discussed. The men are provided with an outline to aid them in their studies and will prepare a complete report on the lumbering operation which they investigate. They are also placed during the summer vacations where they will get the most practical experience in forestry.

To get the men in touch with practical forestry as it is being carried on by private individuals through the State and in its various forest nurseries as well as the work of manufacturing companies who put out tools and equipment used by the forester, one or more trips are made each year by the juniors and seniors, and it is planned to increase in so far as possible the usefulness of these trips. The students have visited various plantings of locust made by the Pennsylvania Railroad along its lines between Harrisburg and Philadelphia. In these plantations they studied the injury done by the locust borer and by mice and have learned that the locust was not a tree of value for general planting throughout the State. At Pottsville the forestry work carried on over the Stephen Girard estate has been carefully studied. On this estate extensive planting has been done, but without the best results because of injury from fire. Stone walls have been built and fire lanes or roads established which are as good an example of this method of preventing fire as can be found in the country. The advanced students have made trips through the southeastern portion of the State, visiting the large forest nursery of the Pennsylvania Railroad at Morrisville, which has been established by the Pennsylvania Railroad. This is reported to be the finest forest nursery in the United States. It had a million and a half of red oak seedlings grown from acorns which were set out in the spring of 1909. Industries associated with forestry, such as works showing the way in which wire rope and cable are used in logging operations, have been visited, and where the students were able to see the making of all classes of saws from the crude material to the finished product.

This brief outline gives an idea of the broad and comprehensive scope of the instruction as carried out at this institution, but the opportunities for the graduates are such that the school authorities consider the work well worth while. There is such a constantly increasing demand for the trained foresters that it is much greater than the number who now graduate, while the salaries offered make it an inducement to a young man to take it up. The college continually has requests from large lumber companies throughout the country for graduates and sometimes undergraduates. The United States Forest Service is also another source of employment, and this institution has already sent quite a large number into the national forests in Montana and other States. In fact the demand for graduates is assuming such proportions that expert forestry will undoubtedly become a vocation which will give many thousands employment, and the results at the Pennsylvania institution prove that similar schools established in other parts of the country will be of far reaching benefit in solving the problem of conserving the national woodlands.

At the head of the State College is Dr. Hugh P. Baker, a graduate of the Yale Forest School, who was also connected for several years with the United States Forest Service. The State authorities have provided Dr. Baker with a staff of experts so that, as already noted, not only instruction but field work has been provided in literally every detail which concerns this subject.

In Pennsylvania forestry is taken up in connection with the work of the agricultural and mechanical departments of the State University, as it is believed this is the best method. As forestry is a production of a crop from the soil, in a sense it is agriculture, and because the utilization of the crop demands considerable knowledge of engineering, the instructors are able to give the students work in the departments of civil, mechanical, and mining engineering—just the kind of employment that they need. Consequently the work is closely connected with the vocation of the farmer, and the one who completes the course of study with the view of becoming an agriculturist is in a position to get the most and best of his woodland and to make it a permanent resource.

It may be added that the length of this course is four years, the first two years of which are devoted largely to foundation principles, which are absolutely necessary to the proper training of the forester. Beginning with the third year they take the men and give them two solid years of training along forestry and closely related lines. In connection with the actual forestry work the students take such subjects as fish and game preservation, diseases of trees, roads and trails, elementary irrigation engineering, elements of mining, in which they are taught in an elementary way the mining of various minerals, the timbering of mines and the laying out of mining claims. The students are also given a practical course in timber testing in their mechanical engineering department.

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AN ELECTROMAGNETIC DRILL

BY THE GERMAN CORRESPONDENT OF THE SCIENTIFIC AMERICAN

A very efficient electromagnetic drill has recently been designed by the German engineer Burckhardt. This machine is intended for use in all branches of the iron industry, e. g. in boiler shops, ship yards, erecting shops, and the like.

The ingenious combination of an electrical motor with an electromagnet adapts this machine to all boring, milling, countersinking and broaching. Electromagnets placed on both sides of the drill spindle throw the machine so tightly against the work as to allow any one of the operations mentioned to be carried out rapidly.

A NEW ELECTROMAGNETIC DRILL.

A special attachment on the drill spindle allows the tool to be rapidly and accurately centered on any given point of the working surface. The machine is thus adjusted within a few seconds.

As represented in the accompanying figures, the drilling machine is suitably suspended for this purpose. On horizontal surfaces the drill can obviously be used without any suspension. A special device is used in upward drilling.

The electromagnetic drill comprises four main parts, viz., the driving motor, the drill proper with its centering device, the electromagnets, and the suspension.

The motor armature drives the drill shaft through a normal toothed wheel gearing. The shaft can be axially displaced with a view rapidly to adjust the drill point on the center mark. The balanced suspension device can be used for the same purpose.

The electromagnets are placed on a yoke pivoted in the plate extension of the machine, and fixed with a nut. The magnet yoke, with its two coils, can accordingly be adjusted to any desired angle. A clamp screw is used to hold it in position.

The pole pieces fitted to the ends of the magnet coils are interchangeable, their length and shape being adapted to the tool in actual use, as well as to the form of the working surface. The [illegible] must be held as tightly as possible [illegible] with their entire surface. The suspension [illegible] should be fixed at such height above the [illegible] as to allow the drill to be rapidly conveyed [illegible] point of the shop. The tool is preferably a [illegible] drill of hard tool steel.

By employing pole pieces of different heights, [illegible] of different lengths can be used.

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The Psychology of Reading.

Examinations made by Erdmann and Dodge may serve as a foundation for the psychology of reading, and through careful experimental observation these scientists have reached results of extraordinary interest.

Hitherto two views have prevailed, the one being that reading was effected solely by spelling, each letter therefore being grasped and perceived for and by itself; the other being that the words were grasped not exclusively letter by letter but in small groups of letters in the same spaces of time.

We learn from their report in the Zeitschrift fuer Psychologie und Physiologie der Sinnesorgane that Erdmann and Dodge first ascertained through reflection of the left eye, while the head was kept in a steady position, that in reading an easily comprehensible text there is a regular change between pauses of rest for the eye and its movements. The number of these pauses, however, is much smaller than the number of the letters over which the eye glides, and it remains, in the case of the same person, almost unchanged as long as a fluent text is used. If the text becomes more difficult in the meantime the number of pauses is increased a little, and where attention is given exclusively to the formation of words, as in "proofs," the number becomes three times as large.

So much having been ascertained, the next object was to ascertain whether reading was effected during the pauses of rest or whether the letters presented themselves with sufficient distinctness while the eye was moving to the right. Through perfectly exact observation and calculation both investigators came to the conclusion that reading was effected exclusively during the pauses of rest. On an average the eye glides during a definite movement on the line over a space of 1.52 to 2.08 centimeters, a space that contains about twelve to thirteen letters. The rapid change of the black and light textual elements—the letters and the interstices—makes it more impossible for the eye to recognize the letters while it is in motion. It was also ascertained that by a very brief exercise of vision, while the eye is still, four letters without exception, five at the most, can be recognized at the same time, even when they do not occur in a sequence of words. In the case of such a sequence, however, four or five times as many letters can be read during the same interval of vision. In the short pauses of rest while reading one recognizes the words solely from their optical collective form, if the letters are not too large, and such recognition is by so much easier as the words show themselves more characteristic and fluent to the reader. Even a beginner can therefore with a little practice enable himself to read not only without spelling but with a visual grasp of whole words at a time. How far this capability may reach depends on the optical memory of the reader.

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Official Meteorological Summary, New York, N. Y., July, 1909.

Atmospheric pressure: Highest, 30.24; lowest, 29.46; mean, 29.93. Temperature: Highest, 92; date, 30th; lowest, 58; date, 4th; mean of warmest day, 84; date, 30th; coolest day, 66; date, 4th; mean of maximum for the month, 81.4; mean of minimum, 65.5; absolute mean, 73.4; normal, 74; deficiency compared with mean of 39 years, 0.6. Warmest mean temperature of July, 78, in 1901; coldest mean, 70, in 1884. Absolute maximum and minimum of July for 39 years, 99 and 50. Average daily excess since January 1st, 1.7. Precipitation: 1.98; greatest in 24 hours, 1.56; date, [illegible]; average of July for 39 years, 4.32. Accumulated deficiency since January 1st, 1.15. Greatest precipitation, 9.63, in 1889; least, 1.18, in 1907. Wind: Prevailing direction, south; total movement, 7,923 miles; average hourly velocity, 10.6; maximum velocity, 40 miles per hour. Weather: Clear days, 12; partly cloudy, [illegible]; cloudy, 5; on which 0.01 inch or more of precipitation occurred, 5. Thunderstorms: [illegible] July in 13 years.

Handy Man's Workshop

HOW TO MAKE CONCRETE POTTERY—V

BY RALPH C. DAVISON

(Continued from the issue of July 31st)

After having mastered the processes of modeling and casting as explained in the previous articles the craftsman can now take up the decorative features The possibilities of ornamentation one can say are almost unlimited with this material Various effects can be obtained One can reproduce antiques which can hardly be told from the originals and original designs embodying various colors can be made which will compare favorably with modern clay pottery effects. Owing to the material used the texture obtained is one which is full of life and sparkle It has a distinct characteristic of its own which cannot be obtained in any other material

As a specific case of what can be done along these lines we will take the copy of an antique which is illustrated herewith This was made as follows It was first cast with perfectly smooth sides, a mixture of one part Portland cement to two parts of fairly coarse brown sand being used After pouring this mixture it was allowed to set in the mold for from eight to twelve hours The mold was then removed and the piece was found to be in a more or less soft state. That is it had to be handled carefully and the concrete had not become so hard that an impression could not be made in it with the sharp point of a knife the design as shown was then marked on the surface, and in turn it was cut and dug out by a strong knife blade A straightedge was placed along the various lines being used as a guide for the blade The depth to which the design should be cut varies according to the size of the piece but in small work usually from one-eighth of an inch to three sixteenths of an inch will give the most effective results If for any reason one cannot commence the work of cutting out the design within twelve hours after the piece has been cast or until the piece has become quite hard it will then be necessary to use a small hammer and chisel with which to cut out the design Care should be taken however in using these tools not to strike too hard a blow for if one hits too hard the piece may break although in antique work if the edges of the cut-out design are more or less irregular it makes the piece so much more effective

In preparing any article for color inlay work which has been modeled and built up on wire forms as explained in numbers I and II of this series such as a vase or other piece the design must be cut out previous to the inlaying of the colors exactly as has been just described for antique relief work

If, however, the piece to be inlaid is to be made in a mold as described in articles III and IV the mold can be prepared to form the desired depression in which case the design will be cast in the piece For complicated designs of this character a clay model must be provided from which the plaster mold is made But in simple designs such as illustrated the piece which is to form the recess can be attached to the inside of the outside mold as shown in Fig 24 This can be made of wood and can be secured in place by brads. It should be located in the proper position and should be of the exact size and shape of the outline of the design and at least one-eighth of an inch thick Shellac and oil the piece well before pouring the cement and allow a good bevel or draft on all of the edges so that it will draw out easily from the cast and thus leave a good clean, sharp edge in the cavity into which to lay the colored ce[illegible]

[illegible] attempts have been made to produce satisfactory color work in cement, but until of late these attempts have been most unsatisfactory This was largely due to the fact that ordinary Portland cement is of a gray color and on mixing it with the various color pigments the result was a decidedly dirty or dead tint of the color used similar to that which would be produced in water colors by mixing them with water which had already been discolored by India ink or lampblack Another cause of unsatisfactory results along these lines was the fact that many of those who experimented did not use the proper color pigments the result being that the colors faded out on exposure to the weather The first cause of not being able to produce true tints can now be overcome by the fact that a really true white Portland cement is being manufactured This now can be procured from almost any cement dealer By using this as a base with which to mix the pigments true clear colors can be obtained and by the use of nothing but good mineral pigments known as lime or cement proof colors it is possible to produce shades which will be absolutely permanent

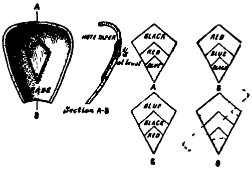


Fig 24—MOLD FOR FORMING THE RECESS AND STEPS IN LAYING THE COLORED CEMENTS.

The writer has experimented largely with coloring matters from this country as well as from abroad Many of the coloring matters obtained from abroad are very good but their cost is naturally higher than those which are made in this country

As before stated mineral colors are those which give the best and most permanent results They all come in powdered form and should be mixed with the dry cement and marble dust or white sand as the case may be until the whole mass is of a uniform tint throughout. After having mixed them as above water should be added and the whole mixed into a mortar

The following pigments which can be procured from almost any of the large manufacturers or dealers in dry colors will give satisfactory and permanent results

Dry Pigments	Resulting Color
Red oxide of iron Venetian red	Red
White Portland cement	White
Ultramarine blue Oxide of cobalt	Blue
Chromate of lead Yellow ocher	Yellow
Chrome oxide of copper Carbonate of copper	Green light Green dark
Lampblack Torch black Black oxide of copper	Black or Gray (according to quantity used)
Ordinary Portland cement	Gray
Burnt umber	Brown

The amount of coloring matter to use in proportion to the cement depends entirely upon the depth or shade of the color desired By mixing up small specimens of the color with various proportions of cement and making small test pieces of mortar and then noting the color of these after they have dried out one can readily determine the proper amount of coloring matter to use It is always better to weigh the amount of pigment used rather than to judge the amount by bulk for by weighing a much more uniform result can be obtained

For ornamental work where a wide range of colors is desired they can be procured by the same means as is used in water or oil color painting that is by mixing together the three primary colors which are red yellow and blue From these three colors can be obtained every color or tone that may be required Thus blue mixed with yellow produces green blue mixed with red produces violet and red mixed with yellow produces orange etc In combining the coloring matters always do so while they are in a dry state and thoroughly mix or grind them together before adding them to the white cement

The method of laying these colored cement mortars in the design is as follows First enough water must be added to the dry mass to allow it to be mixed to the consistency of a thin paste Then the design which has already been cut out as previously explained should be thoroughly wet down by sprinkling with a wet brush

If a varicolored design is to be inlaid it is always well to lay in all of one color at the same time as is illustrated in Fig 24 In this case we have figures *A* *B* and *C* which are to contain the colors red blue and black as indicated First with the aid of the blade of a penknife or any other handy tool according to the size of the work lay the red cement in the design *A* as shown at *D* by the dotted lines Let it come level with or even a trifle higher than the face or body of the vase or piece which is being inlaid also let the colored cement project beyond its position in the finished design as indicated by the dotted lines Now turn the vase around and lay the red cement in the designs *B* and *C* letting it project beyond its position as was done in the design *A* The red cement which has been laid in the design *A* will now be set enough so that a straightedge made of a flexible piece of wood or other material such as cardboard can be placed over it in the position of the finished design as indicated at *D* by the dotted lines

The sharp edge of a knife can now be used to cut away the surplus cement which projects beyond the edge of the straightedge In cutting away the surplus cement always cut away from the finished design Proceed to cut away all other surplus cement from the other three sides of the design as just described and then in turn treat the designs *B* and *C* in the same manner Now lay in the blue cement in all of the designs in a similar manner and then the black cement If by chance any of the colored cements have gone beyond the designs and onto the face of the vase scrape them off before they harden and then with the back of the blade of the knife which is more or less blunt run around the outline of the designs as well as between the colors using a straight edge as a guide By doing this a distinct parting line is produced between each color and a better effect can be obtained

The colored cements which have just been inlaid must of course be cured so as to harden them up This is done by sprinkling them with water as explained in a previous article

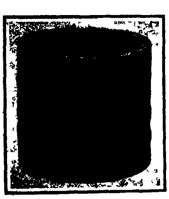
The next article will treat of the molding of ornamental relief work and how to cast it

(To be continued)

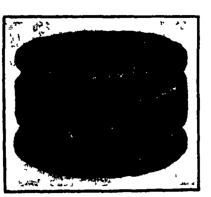
◆

THAWING DYNAMITE

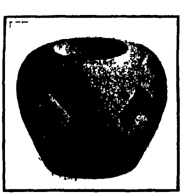
Dynamite must be carefully and thoroughly thawed to make sure that it will explode and do good work The proper thawing of dynamite is a simple operation and is done safely A dynamite cartridge can be lit with a match and burned without explosion almost always It must not be laid against a hot steampipe or smokestack or be buried in hot sand or stood near a fire Use a heat that can be controlled and that can never rise above 100 deg even when neglected Dynamite begins to undergo a change at 1[illegible]8 deg. F and from that temperature up becomes more sensitive to shock until at a temperature of about [illegible]6 deg it will explode simply from that heat The best thawer for dynamite is one in which the cartridges are in



VASE WITH ELABORATE COLOR DESIGN



COPY OF AN ANTIQUE



A GOOD EXAMPLE OF COLORED CONCRETE WORK

serted in tubes that are completely surrounded by hot water The sticks may be carried to the work in this thawer Never place the thawer over a fire, or try to heat the water while the dynamite is in it For thawing on a large scale a building heated with steam or water coil is good, provided primers men, and tools are kept out

◆

AN ELECTROLYTIC RECTIFIER FOR CHARGING IGNITION BATTERIES.

BY FREDERICK E WARD

It is well known that small storage batteries, such as are used for automobile ignition are very easily charged by connecting them to a direct-current house lighting circuit through a suitable resistance but where the current supply is alternating many have supposed that good results cannot be obtained without the use of complicated and expensive apparatus for converting the alternating into direct current By following out the instructions given below however an electrolytic rectifier suitable for charging a six volt sixty ampere-hour battery from 110 volts can be made and used at home with small expense and satisfactory results

There are two parts to the required apparatus—the autotransformer for reducing the voltage of the line from 110 to that required by the battery and the electrolytic cell for rectifying the current or causing it to pass always in the same direction

The autotransformer is shown by the drawings in Fig 1 It consists of a single coil of magnet wire wound on a rectangular wooden spool inside of which a bundle of steel strips is afterward placed to form a core The spool is best made of well seasoned white pine or whitewood as these soft woods are readily obtained and easy to work It is a good plan to dry the wood thoroughly in an oven before it is cut up

For the body of the spool four pieces 2 1/16 inches wide 4 inches long and not thicker than ¼ inch are required These should be securely glued and nailed together so as to form a rectangular tube 4 inches long and measuring 1 9/16 inch by 2 1/16 inches on the inside For the heads two pieces ½ inch thick 3½ inches wide and 4 inches long are needed Through the middle of each a hole about 2 1/16 inches wide by 2 9/16 inches long should be cut to fit snugly over the ends of the tube When the heads are securely glued to the central tube and braced by a few wire nails driven into them from the inside the whole will form a strong spool having a space 3 inches long between the heads for the winding The corners of the tube where the wire is to be wound must be well rounded off with a file to avoid the difficulty of having to bend the first layer of wire around square corners In one of the heads two small holes and a saw cut must be made as shown at 1 2 and 4 in Fig 1 while in the other head only one saw cut 3 is needed These holes and slots are for bringing out ends and loops in the winding so that connections may afterward be made to different parts of the latter On the heads of the spool the numbers 1 to 4 should be plainly carved to avoid confusion

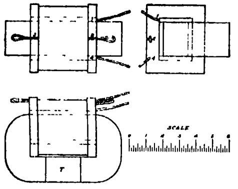


Fig 1 THE AUTOTRANSFORMER.

The coil is to be wound of No 16 double cotton covered magnet wire of which about three pounds all in one piece will be required This is to be wound on the spool in eight layers of about fifty turns each as follows First pass about 4 inches of one end of the wire out through the hole numbered 1 and then wind on six even layers like thread on a spool The work can be done most easily by clamping the spool on the face plate of a lathe and turning it over slowly by hand as the winding progresses It is well to give each layer a coat of shellac before winding the next When the six layers have been put on make a short loop in the wire at saw cut marked No 2 and allow the loop to project outside an inch or so as shown Continue the winding as before and at the end of the seventh layer leave a similar loop at saw cut No 3 and finally finish by putting on the last or eighth layer and passing the end of the wire out through hole No 4. After the winding is complete it should be protected from possible injury by a covering of two or three layers of cloth fastened with glue or shellac

The core is to be made of strips of thin sheet iron or sheet steel cut two inches wide One sixty-fourth inch is a desirable thickness, but anything less than 1/32 inch will answer About eleven pounds will be needed for the core, in strips of different lengths varying all the way from 11 up to 21 inches long Insert the strips into the hole through the spool one by one putting in the longest ones first at the side nearest where the terminals are brought out, and finishing up with the shorter pieces at the opposite side Enough strips should be used to fill up the hole snugly If the strips are rusty it will not be necessary to insulate them from each other but if they are clean and bright it is a good plan to insert an occasional strip of paper so as to divide the core up into groups of half a dozen sheets each

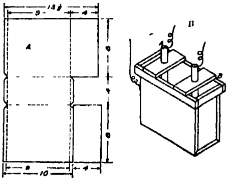


Fig 2 —THE SHEET-LEAD TANK

The strips must next be bent around one at a time so that their ends meet at the side of the coil opposite the terminals Trim off the ends of each strip with a pair of tinner s snips so that they meet without overlapping forming what are known as butt joints Care should be taken that the successive joints do not come in the same place but overlap each other about two inches as they pile up in the same way as the joints in brickwork After the ends are all in place they may be held permanently by wrapping them with a layer of stout cord (not wire) as shown at T Fig 1 This completes the autotransformer though a coat of black paint will improve it

The electrolytic cell consists of a lead tank nearly filled with a suitable liquid in which are immersed two rods of aluminium supported by a light wood frame as shown in Fig 2

The tank should be made of sheet lead not less than 1/32 inch in thickness A good size is 4 inches wide 9 inches long and 8 inches deep Fig 2 indicates how a piece of the sheet lead 14 by 20 inches may be used most economically Cut out the two pieces as shown fold on the dotted lines so that the joints lap on the outside and solder the seams heavily with ordinary solder Do not try to use a lead lined wooden tank as the success of the apparatus depends largely on the cooling effect of the surfaces exposed to the air

For the electrodes two round aluminium rods ⅜ inch diameter and 6½ inches long are required These must be of commercially pure aluminium and not the so-called hard stock' or alloy Fasten to one end of each rod a piece of No 16 copper wire to serve as a terminal The best way to do this is to drill a small hole through each rod near one end and then insert the wire and drive down the aluminium with a center punch until the wire is tightly pinched (See Fig 2A) The tank itself also serves as an electrode so that it is necessary to solder a wire to it somewhere on the outside The aluminium rods are best supported in the tank by means of a light wooden frame made of six pieces as shown at B into which the rods may be clamped by thin wooden wedges driven in where they pass through the holes

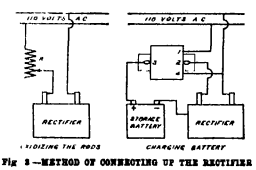


Fig 3 —METHOD OF CONNECTING UP THE RECTIFIER

To make up the liquid for the cell, put two pounds of crystallized sodium phosphate in the tank and fill up the latter with about one gallon of lukewarm (not hot) water or enough to fill it to an inch from the top Stir with a stick until the salt is dissolved and then adjust the aluminium rods so that they dip into the solution three inches.

Before the apparatus can be set at work the rods must be coated with a film of oxide This has to be formed by the alternating current itself, for which purpose the rods may be temporarily connected to the 110-volt power mains as shown [illegible] in Fig. 3 A resistance, R, of about [illegible] used to prevent too much current [illegible] first. After half a minute this resistance [illegible] gradually reduced to zero, and the operation [illegible] completed.

For actual service the autotransformer, rectifying cell and storage battery are to be connected up as shown in the second diagram in Fig. 3. The autotransformer may be connected to a 110-volt lamp socket by means of a sufficient length of No. 16 lamp cord and an attachment plug A two-ampere fuse should be included in the circuit.

The windings of the autotransformer have been so proportioned that when connected to 110 volts about 2½ amperes will flow through a six volt, sixty-ampere-hour battery This low rate of charging contributes to long life of the battery and at the same time minimizes the amount of attention necessary in charging, since an overcharge at low rate does very little harm. With ordinary use of an automobile, a ten-hour charge over night every two weeks will keep the battery full and in good order

After about fifty or sixty hours' use of the rectifier the sodium phosphate solution will become exhausted. This will be indicated first by unusual heating of the tank and autotransformer due to leakage currents and finally by the blowing of the main fuse and possibly the discharge of the battery back through the tank and coil It is therefore necessary to make up a fresh solution for the tank and reoxidize the rods after about fifty hours' use or when excessive heating is first noticed

The aluminium rods last a long time, and when the lower ends become worn thin they may be inverted if care be taken to remove every particle of the copper connecting wires.

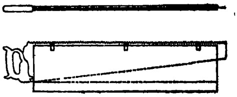
The apparatus will charge an eight-volt battery, if necessary but at a slower rate and it can also be used on a four-volt battery in an emergency In the latter case the large currents may soon cause overheating unless a resistance of about one ohm be connected in series with the battery

◆

SAW FILING CLAMP

BY C A PITKIN

The saw clamp described by Mr Bayley in the SCIENTIFIC AMERICAN of May 15th is of service in the workshop and I should like to submit a modification of it as used by carpenters and others when the facilities at hand are limited



HANDY SAW-FILING CLAMP

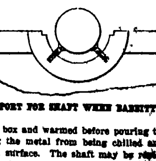
Oftentimes when one wishes to file a saw, while away from the shop and having no filing clamp at hand he is at a loss to know how to firmly hold the tool during the operation A handy expedient is to take a board or joist and turning it on edge, end on, make a cut with the saw to almost its depth. Then place the saw in the cut teeth uppermost, and drive in several small wedges along one side This always holds the saw nicely and the whole may be nailed to a step sill or part of the framing or may be placed in a carpenter s vise To loosen the saw, strike the top of its handle with the hand

◆

TO SUPPORT SHAFT WHEN BABBITTING.

BY J EDWIN KERR.

This is a suggestion for the simplification of the babbitting of crankshaft boxes, which has been used a number of times with entire satisfaction. Drill two holes about ¼ inch from the outside end of the box and in about the position shown in cut. Tap the holes for small screws. Let the shaft rest on the head of these screws, which may be adjusted until the shaft is lined up. After lining the shaft it may be taken out of the box and warmed before pouring the [illegible] preventing the metal from being chilled and [illegible] an uneven surface. The shaft may be replaced [illegible] warm and the babbitt poured at once, the [illegible] suring a perfect line-up. The screws may be [illegible] with a screwdriver when the babbitt [illegible] or they may be left in [illegible]



SUPPORT FOR SHAFT WHEN BABBITTING.

RECENTLY PATENTED INVENTIONS.

Of Interest to Farmers.

MILKING-MACHINE.—L. L. STORY, East Fairfield, Vt. The object here is to produce a machine which can be readily adjusted in position. While the invention concerns itself with the general construction of the machine, it relates also to the construction of the teat cups and the manner of actuating them in the milking operation.

ATTACHMENT FOR CORN-CULTIVATORS.—H. J. NAVE, Stanford, Ill. In the present patent the invention is an improved cultivating implement designed and adapted to be used as an adjunct or attachment of a cultivator having plows or shovels for use in furrowing between rows of young corn stalks growing in hills or drills.

Household Utilities.

PORTABLE GRATE.—W. H. ROLLAND, Savannah, Ga. The invention is an improvement in fire-place grates, and has in view a grate of the conventional or other design hinged at one side to swing within and to the outside of the fire-place opening, in which latter position it is adapted to be lifted from its hinges and removed for emptying or other purposes.

BROOM HANGER.—J. H. ASHMEAD, Silver Bay, N. Y. An object here is to provide a hanger by means of which a broom can be hung in an inoperative position from a nail or other support, which serves as an additional means for holding the broom straws securely together on the neck of the broom, and is so constructed that the nail cannot become caught in the broom straws to loosen or otherwise injure the same.

ROCKER FOR CHAIRS.—G. M. STRATTON, Carthage, S. D. The purpose of the invention is to provide hollow rockers of sheet metal for chairs, which are light, strong, shapely, and can be produced at low cost. It consists in a novel construction of rockers and their combination with the legs of a chair.

Machines and Mechanical Devices.

SHUTTLE MECHANISM.—J. LARSEN, Silkegade 13, Copenhagen, Denmark. The present invention concerns a horizontal shuttle which is so arranged that it seizes the thread and holds it fast, so that the needle can without stopping go straight down and then again at once straight up, the upper edge of the ring-formed shuttlehead being provided with a horn that holds onto the thread during the formation of the stitch.

APPARATUS FOR MANUFACTURING CIGARETTES.—O. WARTMANN, 681 High Road, Tottenham, London, England. The chief object of the invention is to enable the production of cigarettes which, while formed to a large extent by means of automatically acting mechanism, shall be free from the defects of ordinary machine-made cigarettes and shall exhibit some of the best characteristics of those made entirely by hand.

BUTTER-SERVER.—O. W. MONROE, Seattle, Wash. The construction enables the empty butter dishes to be stacked in a column and removed one at a time, filled with butter, and ejected from the machine. It stops the action and locks movable parts in case of breakage of the wire used for cutting the butter, prevents the stock of butter from moving in the machine except for the purpose of filling a butter dish, provides for effecting the disengagement of butter dishes from the bottom of the column of such dishes, and provides refrigeration and storage of the stock to be used so as to maintain the butter in suitable form to be acted upon by the machine.

DUMPING SCOW.—F. P. EASTMAN, New York, N. Y. The scow has movable sides normally securely locked against opening and which can be readily opened without presenting obstructions to the load, thus insuring a complete and quick discharge of the load, especially when the latter consists of bulky and moist refuse liable to cling to any obstructions in its path. The invention relates to scows described in the Letters Patent of the U. S. formerly granted to Mr. Eastman.

CENTRIFUGAL SEPARATOR.—J. A. B. DOMINGUEZ, Guayama, Porto Rico. The invention admits of general use, but is more particularly applicable to the separation of sugar and molasses from the crude product known as massecuite, or in other words from the material received from the evaporators. Centrifugal force is developed in a rapidly rotating body, and causing such body to exert increased pressure if its direction of motion is suddenly reversed.

Prime Movers and Their Accessories.

ROTARY ENGINE.—F. P. NICHOLS, Houston, Texas. In this patent the invention makes an improvement in rotary engines. In operation the motive fluid being admitted through a hollow shaft, passing upwardly through radial holes and through ports to pressure chambers, acting against the sides of the piston blades to rotate the motor, which comprises the shaft, the casing, and the piston blades.

LUBRICATOR-PUMP.—O. J. AUGUSTA and [illegible], Rock Rapids, Iowa. The invention relates particularly to such pumps as are [illegible] in conjunction with a kinematic element of the engine. Continuity in the oil feed to the pump, the preheating of the oil to be delivered to the pump, and expedients in the regulation of oil delivery, are assured.

Railways and Their Accessories.

KNUCKLE-JOINT CONNECTION.—M. KELLY, Bloomington, Ill. The invention refers to pivotal connection between the connecting rod and the parallel rod of a locomotive, and the aim is to provide a knuckled joint connection arranged to hold the pivot pin tight and to properly press the jaws to prevent lost motion and uneven wear.

RAILWAY TRACK CONSTRUCTION.—J. H. F. SCHULZE, New York, N. Y. In this patent the invention is an improved construction of railway tracks, and has for its purpose the provision for the easy removal and replacement of the head of the rail, which is the only part worn, without interfering with the rail connection with the road bed.

RAILWAY SWITCH.—T. MCGRATH, Denver, Colo. The present embodiment of this invention comprises a plurality of switch throwing devices arranged on each side of the switch, a locking device for locking the devices in thrown position and for insuring its complete throw, and a hand operating device which normally is disengaged from the switch.

CAR COUPLING.—H. C. CANNON, Memphis, Tenn. This coupling is of the Janney type. In operation, when the parts are coupled, the operating bar will be in its outermost position and its serrations will be detached or out of interlocked engagement with serrations of the tongue. If the bar be now moved inward it will first lift the locking dog to uncoupled position and then will move into interlocked engagement with the tongue of the coupling hook and will throw the hook to open position.

Pertaining to Recreation.

BILLIARD CUE.—I. KALMANOVITZ, New York, N. Y. The improvement pertains to cues, and more particularly cues having removable tips, means for securely and removably mounting the tips in position, and, if so desired, between the tips and cue a body of resilient material which increases the effect of the blow when the cue strikes the ball.

Designs.

DESIGN FOR A SPOON, FORK, OR SIMILAR ARTICLE.—H. I. ROGERS, Albion, Ind. The ornamental design presented is an interesting administration design including the representation of an opossum at one end of the handle, a boll of cotton on the other end, and a sweet potato intermediate its ends.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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INDEX OF INVENTIONS

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AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

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Bearing, ball, I. H. [illegible]	929 [illegible]
Bed, folding, E. J. Crouch	929 [illegible]
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[illegible] suspending attachment, M. I. Skinn	929 [illegible]
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Binder, loose leaf, S. H. Mitchell	928 901
Binder, loose leaf, C. M. [illegible]	929 [illegible]
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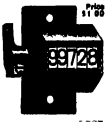

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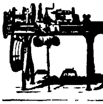

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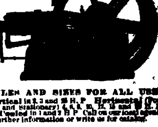

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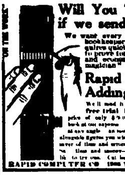

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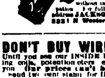

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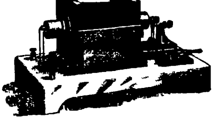

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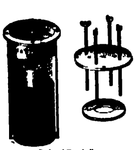

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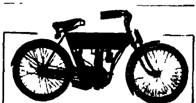

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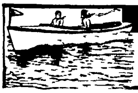

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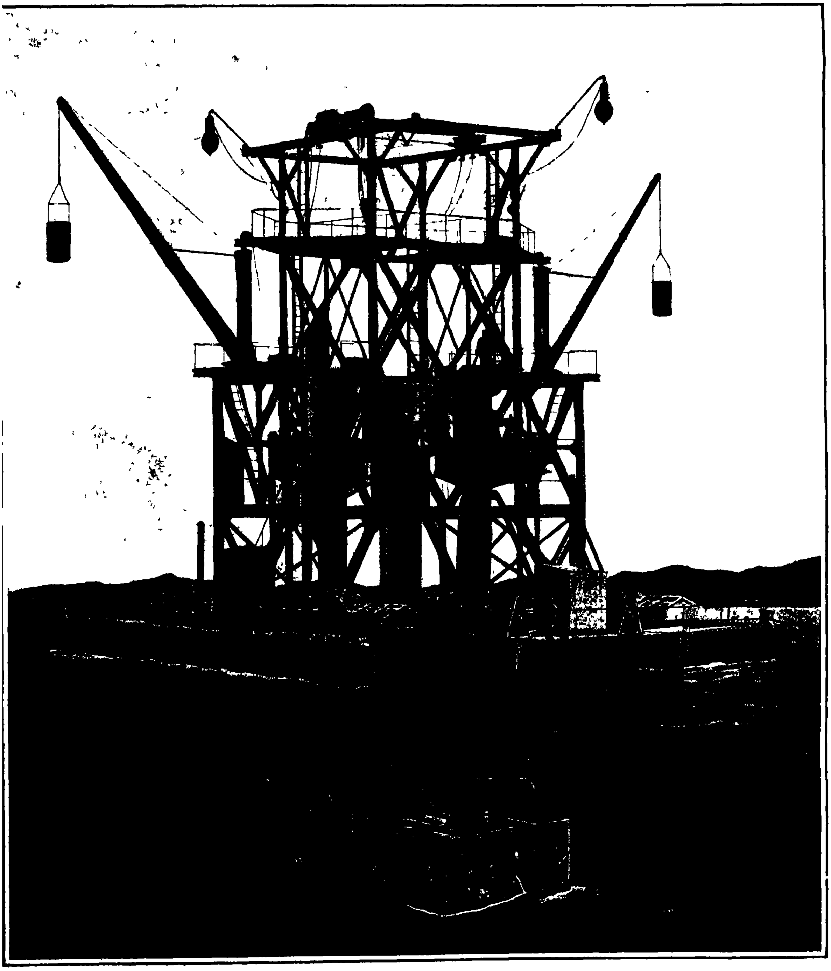

Excavating apparatus for the German navy, consisting of a diving bell carried by pontoons from which it is entered and operated.

A NEW APPLICATION OF THE DIVING BELL.—[See page 127.]

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NEW YORK SATURDAY AUGUST 21st, 1909

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest If the photographs are *sharp*, the articles *short* and the facts *authentic* the contributions will receive special attention. Accepted articles will be paid for at regular space rates

RACING YACHTS IN A GALE

The recent run of seventy vessels of the New York Yacht Club from Martha's Vineyard around Cape Cod to Portland harbor afforded a supreme test of the seagoing qualities of the modern racing yacht The distance was 152 miles Not long after the start the wind began to freshen and throughout the night as the yachts fought their way along the coast of Cape Cod it increased to what was probably a moderate gale The fleet was so roughly handled that the majority of the boats were scattered during the afternoon and night and the following morning found refuge in the various harbors from Vineyard Haven to Portland Of those that completed the run or rather race, for such it was F F Brewster's 90-foot schooner 'Elmina went through without any mishap covering the 152 miles in 22 hours 36 minutes and 38 seconds elapsed time Equally meritorious was the performance of Cornelius Vanderbilt's sloop Aurora, a vessel over 30 feet shorter than Elmina' on the waterline which covered the course in 26 hours 11 minutes and 21 seconds beating Mr W E Iselin's 90-foot yawl 'Vigilant the old America cup defender, by over 9 hours. The Aurora was navigated throughout by Mr W Butler Duncan Jr who says that the one-design Herreshoff yachts (the class consists of the "Aurora Istalena and Winsome) could hardly be surpassed in their weatherly qualities and were not in the least danger in the seaway Nevertheless, the fact remains that a moderate summer gale sufficed to scatter this fleet of seventy vessels completely disabling many of them and driving the greater part of them to the shelter of the nearest harbor The casualties comprised almost every kind of a disaster that can befall sails and spars, running and standing gear from complete wreckage as in the case of the Eleanora, formerly the Effort whose mast went by the board, carrying bowsprit and everything above deck with it to the breaking of the jaws of the gaff and the parting of blocks and the minor mishaps so well known to the racing yachtsman The many casualties merely emphasize the fact already well known to experienced yachtsmen and designers that the enormous spars and big sail plan of the modern racing yacht are ill adapted for a thrash to windward in a heavy sea and wind Although when a racing yacht is staggering along under her full press of canvas the strains in spars shrouds and stays run up to a very high figure they evidently do not equal the more violent strains which occur under the sudden snappy plunging and lurching of a vessel that is being driven under reduced canvas in a short and lively sea. The result of this experience of a summer's gale will be to bring the moderately sparred and more comfortable cruiser into greater favor with the average yachtsman

PEARY AND THE NORTH POLE

Public interest in the present attempt by Peary to reach the North Pole has been reawakened by the recent start of the schooner Jeanie' from St John's, Newfoundland for Etah west Greenland, for the purpose of getting into communication with the explorer, who has now been absent over twelve months on his present expedition to the North Pole When Peary left in the Roosevelt,' about twelve months ago, he planned to push as far north as the ice would admit and then establish winter quarters and make preparation for a dash by sled between March and June of the present year If he were successful he planned to return to Etah with the ship if possible and if not, without it If he failed to reach the Pole, it was his purpose should another attempt seem to promise success to remain in the North till the summer of 1910 and make another attempt in the early months of that year If any disaster has befallen the Roosevelt," the schooner will probably find Peary at Etah awaiting her arrival, and he will be there if he has succeeded in reaching and returning from the Pole. Should he have failed in his quest, he will still be far away to the north, and the schooner will bring back such dispatches and reports as he may have sent down. Possibly the vessel will also bring back Dr F A. Cooke, of Brooklyn, who went north two years ago and was landed at Etah to undertake a trip to the Pole with a single companion The last word from him was sent back by a native when he was about to go out over the Arctic ice on his quest If all goes well the return of the vessel may be looked for about October 1st, when some definite news of Peary's work may be expected

TWENTY MILES UNDER THE SEA

The rapid progress of the arts and sciences in these opening years of the twentieth century affords opportunity for the enjoyment of novel situations and sensations which were possible only in the dreams of the enthusiast of an earlier day Thanks to official courtesy the Editor was recently afforded an opportunity, during the trials of the latest submarines built for our navy to make a run of some twenty miles below the surface of the water in one of these always interesting and to-day extremely formidable craft.

A little removed from the long lines of battleships, destroyers, and auxiliaries, that were moored during the recent summer maneuvers in Provincetown Bay, was the converted hull of an old wooden sailing brig, the property of the Fore River Ship Building Company which acted as "mother ship' to a group of submarines, recently constructed by that company which had been brought to Provincetown for their official government tests Selecting the Stingray' one of the largest submarines, for the reason that her trials for the day were to be carried on entirely below the surface, we went aboard, and found ourselves on a narrow flat deck, about five feet in width and sixty feet in length which covers in the superstructure a light construction of steel plating built upon the hull of the submarine proper, and perforated so as to allow a free entrance and exit of the water A steel hand rope, carried in removable stanchions surrounds this deck Extending up through the center of the deck to a height of about five feet is a narrow elliptical tower, on top of which is the sighting hood or conning-tower, pierced by several little glass-filled ports for observation Just in front of the conning tower is a removable navigating bridge used when the ship is at the surface. In front of this are the two tall tubes of the periscopes, which are in duplicate

The ship was driven to the outside mile course by the electric motors, the gasoline engines which are used for propulsion on the surface in extended runs being uncoupled The first surprise of the day was the extraordinary smoothness of the motion, there being not the slightest vibration to indicate that the vessel was under way As we approached the course orders were given to dismantle the upper works and send everything below The wire handrope around the deck was removed the stanchions lifted from their sockets the navigating bridge on the conning tower was knocked down, and all of this material, with the steering gear, compass, etc, was handed piece by piece, through the manhole, until the ship was stripped clean for the dive As soon as everybody had gone below the manhole was closed and the submarine was ready for her first run over the measured mile course Below decks throughout the five hours below the surface we were struck with the purity and sweetness of the air and the absence of any odor other than that of the last coat of paint which the interior had received Forward side by side we noticed the two torpedo tubes. Aft, beyond a bulkhead, were the twin gasoline engines, and abaft of them the two motors, the former used for charging the batteries and for propulsion when the ship is at the surface, the latter being used exclusively for propulsion when the ship is submerged

While making the trial runs, the steering is done by a man in the conning tower Immediately below him standing on the deck is the lookout, with his eye at the periscope Facing the side of the vessel, another man controls by means of a handwheel, the diving rudder and holds the vessel at its proper depth. At various stations were men with their hands upon the wheels and levers that regulate the ballast tanks for giving the proper submergence and trim to the vessel aft were the engineers.

It will be remembered that when we went below, the submarine was floating at the depth for surface cruising The first operation was to admit sufficient water into her tanks to sink the boat to the awash condition and in sharp succession the commands came, 'Fill the main ballast tank," "Fill the forward trimming tank," "Fill the after trimming tank" Immediately one could hear the rather ominous swish of the water as it rushed into the vessel Instinctively our eye followed the pointer on the large depth gage, which was fastened on the side of the submarine in front of the man who controls the diving rudder The tanks were left open till a depth of five feet was registered Then came the order to start the engines which was shortly followed by the sharp word of command. "Dive." A few swift turns to the handwheel were followed by a curious dipping or lurching sensation, as the submarine, impelled by the downwardly-deflected rudder astern, changed from the horizontal to an inclination of about five degrees, and began to go down The descent was shown at once on the depth gage, which moved quickly to indicate eight, ten, twelve, and ultimately fifteen feet, the depth at which the runs were to be made.

It should be explained here that the handling of the diving rudder is the most delicate operation, and the one requiring most skill and judgment, connected with the submarine The rudder must not be put down too suddenly, or there may be too precipitate a plunge. At 9 5 knots, the speed at which the run was made, it took about five degrees of rudder to make the dive. The submarine going down had an inclination of three and a half degrees. To keep her on an even keel when submerged, it was necessary to give her about one and a half degrees of the diving helm. This is due to the fact that when the submerging tanks are filled she does not take in sufficient water ballast to entirely sink her but is adjusted with a reserve buoyancy of about 1 000 pounds. To correct this buoyancy, it is necessary to keep the helm slightly down when she is running. To reach the fifteen-foot depth takes from fifty seconds to a minute and a half, according to the speed at which the boat is being run.

The mile course was laid out about half a mile off shore, the start, finish, and quarters being marked by pairs of ranges set up on shore The instant of passing the ranges was noted by the man at the eyepiece of the periscope, which was swung around at right angles to the axis of the boat. As each range passed the field of the periscope, the observer called out 'Mark the time being taken by observers both on shore and within the submarine When the mile course had been covered which was done under full power at the rate of nine and a half knots, the diving rudder was put up and the same curious change of level was felt as when the dive was made.

Perhaps the most surprising thing about this five hours' trip below water was the fact that, even when the boat was being driven at the highest speed there was practically no vibration and absolutely no indication that the water was sweeping by the vessel at a speed of nearly twelve miles an hour The only sound was the slight hum of the electric motors, punctuated by an occasional word of command from navigator or engineer As far as any indication of sight or sound was concerned, the cabin might have been that of any ship that sails the surface of the sea in the orthodox manner The first suggestion that the boat was alive with movement came when, at the end of the run the submarine thrust her nose above the surface, when the swish of the broken water at the bow could be distinctly heard After making a wide turn and heading for the course the rudder was put down, a dive to the fifteen feet depth was made, and under a reduced speed of about eight knots, the course was again covered This was repeated, until the twelve runs scheduled for the day's trial had been completed the speed of the successive runs varying from nine and a half down to a minimum of about four knots. The engines were standardized by counting the revolutions corresponding to the various speeds.

A look through the eyepiece of the periscope, while we were submerged, removed the last doubt as to the ability of the submarine to "see" By means of a handwheel the periscope may be swept rapidly around the whole horizon, and so perfect is the reflection of the little mirrors, that we were able to pick out any particular battleship yacht, or object on shore, with as much ease and as perfect visibility as if we had stood six or eight feet above the water, at the level of the object glass at the top of the periscope. The operator stated that in rough weather the wash of the waves keeps the glass clean and does not interfere with vision.

There can be no question that the submarine has at last 'come into its own" Among the captains of the battleships and the line officers in general at Provincetown, there was noticeable a growing respect for these craft, due to the varied and accurate work which the flotilla had accomplished during the summer maneuvers. There has been a steady but slow growth in the speed of the submarine. Its control is now perfect, and its radius of action is being rapidly increased Our largest boats have a radius of about one thousand miles, and two are under construction on the Pacific coast which will have a cruising radius of about three thousand miles. This means that the submarine is taking on full seagoing qualities. It must no longer be regarded as restricted to seacoast operation. The time is not far distant when an admiral searching for the enemy upon the high seas may include a submarine flotilla in his fleet. The profound significance of this fact upon strategy and tactics will be appreciated by every naval expert.

ENGINEERING.

The New York, New Haven & Hartford Railway Company are about to make tests of the comparative performance of electric and steam locomotives in freight service. To this end they have ordered two freight locomotives. One of these is to be equipped with side rods, and the other will be of the geared type.

Statistics of accidents on the railways of the United Kingdom for the year 1908 show that in accidents to trains, rolling stock, or permanent way no passengers were killed, but 282 were injured while of employees, 6 were killed and 164 injured. Accidents of a kind other than the foregoing included 102 passengers and 376 employees killed, and 2 240 passengers and 4 976 employees injured.

The "Alagoas," the seventh of ten torpedo-boat destroyers ordered by the Brazilian government was successfully launched by Messrs. Yarrow & Co. of Glasgow on July 29th. Like her sister vessels she is 240 feet long by 23 feet 6 inches beam, and will be equipped with two doubel-ended Yarrow boilers of 4 000 horse-power capacity, supplying the two sets of 4 cylinder triple-expansion engines, refrigerating apparatus and other auxiliaries.

In a recent paper W E Gray states that the manufacture of tin plates originated in Bohemia hammered iron plates having been coated with tin in that country some time before the year 1600. Tinplate making was introduced into England from Saxony in 1665 and the first tinplate factory in France was established in 1714. Tin plates were first made on a commercial basis in the United States at Pittsburg in 1872.

According to Railways of Calcutta, the success of the monorail system in India for carrying freight and passengers is largely a question of finding a satisfactory type of carriage and Mr Brennan is now making experiments on short lengths of roads in India to determine this question. The monorail system is believed to possess great value because of its simplicity and cheapness of construction for military purposes on mountain roads. The result of the experimental work will be given in a forthcoming report.

The Jamaica Bay Improvement Commission will shortly make a survey for the bulkhead line which will be built at about 2 000 feet from the westerly and northerly shore of the bay and will extend from Barren Island to Three Mile Creek. The government will dredge a channel which will ultimately be 30 feet deep and 1 000 feet wide. The dredged material will be used to fill in the 1 250 acres between the bulkhead and the shore line. In the earlier stage of the operations it is proposed to dig the channel to a depth of 18 feet and a width of 500 feet.

The work which has been done in the electrification of steam railroads has probably suffered from the lack of collaboration between the different railroads and interests that have been engaged in such work. Hence, it is gratifying to note that the New York Railway Club has appointed a special committee to take up the subject during the coming fall and winter and report at the annual electrical meeting of the club in March next. They will collect data and make suggestions as to the direction in which further investigation should be made. Substantially the same action has been taken by the Maintenance-of-Way Association and the American Railway Association.

A new record for mining and shipping anthracite coal has recently been made by the Kingston Coal Company of Wilkes-Barre, Pa. During the month of July, that company's breaker No 2 shipped 91 000 gross tons of coal which, as far as we can learn, beats the record of any in the United States. This breaker has been entirely rebuilt during the last six months without any stoppage of its machinery, improved springboard shakers being substituted for revolving screens, and mechanical pickers introduced to dispense with a large number of boys on the picking belts. The breaker worked twenty four full working days of nine hours, the greatest number of mine cars dumped in one day being 1,641.

So vast are the crowds which are expected to gather during the forthcoming Hudson Fulton Celebration, that the Executive Committee have made elaborate plans for the proper care of the health and convenience of the visitors. During the entire time of the celebration there will be open, twenty-four hours a day, a large number of emergency hospitals, provided with telephone connections. A number of physicians and 1,500 trained nurses have volunteered their services. During the three days of the land parades there will be established a temporary emergency hospital at every five blocks, with ambulances stationed at every ten blocks. During the two water events of the celebration, an innovation will be introduced in the form of ambulance launches, with nurses, doctors, and police officers in attendance.

ELECTRICITY.

In recent trials of the Pollak Virag high-speed telegraph between Berlin and Königsberg, a distance of 480 miles, 2,800 distinctly recorded words were transmitted in five minutes.

So successful have been the experiments with the new Telefunken system of wireless transmission at the new 20-kilowatt station of the Austrian government at Pola on the Adriatic that signals strong enough to be automatically printed on tape by the coherers were received at Norddeich on the North Sea, Copenhagen, and Berlin.

The wave forms of electric currents have been made visible by M Abraham of Paris by means of an adaptation of the mirror galvanometer. Upon the mirror being set swinging horizontally by the current the beam of light is thrown upon a revolving prism and a set of fixed mirrors in such a way that it is spread out in the vertical direction so that the wave form of the current appears upon a screen.

The French government, which already had the monopoly of telegraph and telephone operations in France, has extended its legislation to include wireless telegraphy. No wireless telegraph or telephone apparatus may be set up on French territory or ships except where authorized by the state and foreign vessels in French waters may not operate their apparatus in such a way as to conflict with government messages.

Wireless messages transmitted from the Glace Bay station in Canada have recently been picked up with some regularity by the Eiffel Tower receiving station in Paris proving that transatlantic wireless communication is an accomplished fact. The Paris plant is in no way competing with commercial stations being purely for military purposes making no communication with places outside of France except the French African colonies.

The growing importance of the electric vehicle, hitherto somewhat overshadowed by the more showy successes of the gasoline car is evinced by the fact that at the recent annual convention of the Society of Automobile Engineers in Chicago half the papers presented related to electrical subjects. Two of the papers referred to storage batteries and one to measurement of energy consumed by commercial vehicles the most animated discussion of the meeting centering around the latter.

The notable successes of wireless telegraphy in procuring speedy assistance for ships in distress at sea in spite of fog and distance best exemplified by the cases of the "Republic" and the "Ivernia" has caused an application for lower insurance rates for vessels equipped with wireless apparatus to be proposed for the international marine insurance congress at Baden next month. Success of the application should be mutually beneficial both effecting a saving in insurance cost to shipowners using wireless and extending the use of the latter.

Upon the successful completion of tests now in progress of a 5 000-kilowatt unit the New York Interborough Railway will install two more General Electric Curtis low pressure turbines driving 3 phase 25-cycle 11 000-volt generators each of 5 000 kilowatts capacity operated by exhaust steam from existing reciprocating engines at the 59th Street power house. It is estimated that the turbines will take nearly as much power from the exhaust steam as the reciprocating engines do in expanding from 150 pounds pressure to atmosphere.

The Great Eastern Railway of England, with one of the largest termini in London and a great suburban traffic has lost passengers at the rate of 25,000 000 per annum since the advent of the London County Council's electric tramways, and this in spite of a gradual reduction of its fares amounting in some cases to 40 per cent. The council tramways are a municipal undertaking, and while giving good service have been run hitherto at a loss, the deficit being paid out of the rates, so that the railway company as a large ratepayer, is naturally aggrieved at having to contribute to the support of a successful rival.

The Public Service Commission, which has been considering the question of compulsory electrification of railways passing through the Adirondacks forest preserve, as a means of fire prevention in the latter has rejected this remedy on account of its prohibitive cost. The additional cost of operation by electricity was estimated to be $1,156,470 a year more than the present cost of operation by steam locomotives for the New York Central lines alone, that figure being reduced by only $100,000 if all the power were generated by water. This great expense is due to the very unfavorable conditions for electric service the traffic consisting of a few heavy trains over comparatively long distances, whereas economical electrical operation requires a fairly uniform traffic composed of a large number of small trains at small intervals, as in the suburban service of large cities.

SCIENCE.

Capt R F Scott, who recently returned after a thrilling attempt to reach the South Pole in which he was nearly successful has announced his intention of setting out on another Antarctic expedition early in 1910.

That the New York Aquarium is certainly meeting with public approval would follow from the remarkable attendance in July 1909. During that month 528,266 persons passed through the turnstile—an average of 17 040 per day. Up to August 2d 1909 the total attendance was 2 006 919.

It is announced that Lieut Shackleton will lecture in the United States and Canada in order to earn enough money to pay the heavy indebtedness which he incurred on his last Antarctic expedition. The announcement is astonishing as it was generally supposed that Lieut Shackleton had been aided by his government. It is stated that the expedition was financed by a small group of Americans who lost their all in the last financial crisis.

The Duke of the Abruzzi cables that he has ascended Mount Godwin-Austen in the Himalayas to a height of 24 600 feet. He failed by 3 665 feet in reaching the mountain's summit. We believe that although he did not succeed in his ultimate object in ascending this lofty peak he has broken all records for mountain climbing. The Duke had an advantage over the private individuals who were his rivals in the Himalayan field in so far as the government of India furnished him with guides and porters. For all that, his hardships must have been tremendous. The Workmans have stated that climbing in the Swiss Alps is child's play compared with the feats of endurance which climbing in the Himalayas demands.

As aluminium is extensively employed in the manufacture of kitchen utensils it is important to know how it is affected by the foods which are brought into contact with it. For this purpose Plillinger boiled aluminium foil in fresh milk sour milk wine mineral waters and 10 per cent solutions of various salts. The aluminium foil was weighed before and after the boiling which was continued for half an hour. No appreciable loss of weight was produced by boiling in sweet milk white or red wine or solutions of sodium chloride potassium iodide, sodium nitrate potassium sulphate and calcium nitrate and only a very small loss was caused by sour milk. The aluminium was strongly attacked however by sodium bicarbonate magnesium sulphate calcium sulphate and mineral waters.

Garrigon has tested the radio-activity of the hot springs of the Pyrenees by immersing in their waters a photographic film inclosed in a tube of aluminium. The film showed an impression after a longer or shorter immersion while a second film immersed in the same conditions but inclosed in a tube of lead remained unaffected. A very thin sheet of lead suffices to stop the radiations of radium etc which pass through comparatively thick sheets of aluminium. The following experiment of similar character is reported by an Italian scientific journal. A photographic plate wrapped in paraffined paper (to exclude moisture) and then in black paper was placed between two plates of iron 1/12 inch thick which were coated with asphalt varnish. The iron plate next to the sensitive film had five perforations about ½ inch in diameter. The whole apparatus was suspended for 15 hours over a spring with the perforated plate lowermost. On being developed the photographic plate showed impressions of the five perforations. A control plate treated in the same manner but not exposed over the spring showed no impression whatever.

F Robin has made a series of experiments on the hardness of steel at low temperature using a falling ball 2/5 inch in diameter which gave a blow of about three tons. The metals were in bars about two inches long and one inch square. They were placed in three refrigerating mixtures producing temperatures of —4 —112 and —300 deg F. The temperature —4 deg F was obtained by a mixture of ice and calcium chloride the temperature —112 deg F by a mixture of carbon dioxide snow and 95 per cent alcohol. The lowest temperature —300 deg F was obtained by a mixture of liquid oxygen and nitrogen containing a very large proportion of nitrogen. The experimenter finds as Hadfield did an increase in hardness of steel immersed in liquid air but the increase is not progressive, the curve of hardness rising suddenly at —112 deg F and attaining a great height in liquid air. Cast antimony also increased greatly in hardness but cooling had comparatively little effect upon aluminium copper lead tin nickel and some other metals. Spring steel containing silicon shows little change. Chrome steel showed great variation while tungsten steel vanadium steel molybdenum steel, and rapid-cutting steel gained little in hardness on being cooled to the lowest temperature. Quenched steels gained considerably in hardness.

TESTING A TORPEDO-BOAT DEFENSE.

BY AN EYEWITNESS.

A most realistic test of the value of a boom for the defense of harbors against the attack of torpedo craft has just been made by the British Admiralty In 1904 the submarine mine fields which up to that date had been maintained at the entrance to the principal British naval ports were abolished and at the same time the Brennan torpedo—a weapon operated and directed from the shore by means of endless steel wires—was also discarded These changes were followed by the organization of submarine and torpedo flotillas for the local defense of the ports and simultaneously a great deal of attention began to be paid to the question of boom defense

The latest pattern in these obstructions adopted by the British Admiralty consists of a number—generally from 100 to 150—of balks of timber each about ten feet long tied together by four lines of strong steel hawsers At intervals along its length the boom is attached to pontoons which are themselves anchored to the bottom of the channel by heavy mooring chains Each balk of timber is about a foot square in section and is studded with a number of stout curved steel spikes four projecting from either end and others being placed along the length of the balk at intervals of about three feet The object of these spikes is to prevent the 'jumping of the boom—an incident which has occurred more than once in maneuvers It is achieved by all movable weights—including the crew—being taken aft, thus lifting the bow of the vessel well out of water Then, running at the boom at full speed, the nose would be pushed well over the edge of the boom and the impetus of the vessel and the sudden rushing of the men forward again would in most cases prove sufficient to carry the ship safely across A few years ago however a British torpedo vessel broke her back while trying to jump a boom

Destroyer "Ferret" as she appeared when approaching the boom at 15 knots speed

It was of course well understood that any vessel larger than a destroyer could easily break any boom yet devised The British Admiralty however after much discussion came to the conclusion that the only vessels likely to penetrate the outer line of British port defenses were destroyers and torpedo boats (including of course submarines) and it was therefore decided to put to a practical test the problem whether a vessel of one of these types could burst through a boom of the latest pattern

A section of a boom of the latest design was therefore erected across a small creek in the upper reaches of Portsmouth harbor In addition to the spikes already described, the boom was furnished with a three-inch wire hawser stretched about three feet above the balks with the object of shearing the masts and funnels from any destroyer which might have the audacity to charge the boom and to force it down on to the steel spikes Five feet below the surface there was another hawser designed to impede the progress of the ship and to foul its propellers.

The attack was intrusted to the torpedo-boat destroyer Ferret an obsolescent vessel of 280 tons, launched in 1893 Her engines are of 4 810 horsepower the designed speed being 27 knots. For the purpose of the test she was strengthened by means of steel plates fixed to either side of the bow but this was only done to give her a greater resemblance to the latest vessels of the destroyer class. Nominally her crew consisted of seventy men but for the purpose of the trials a volunteer crew of ten was selected Lieut J C Hodgson being in command and Artificer Engineer J Hawkesworth in charge of the engines. Before starting the whole of the crew were directed to come on deck as soon as the vessel got within one hundred yards of the boom and to be ready to jump overboard, while a large number of tugs and launches were in the vicinity to pick up the expected pieces. These facts alone are sufficient evidence that the Admiralty officials did not expect the "Ferret" to get through, at any rate without considerable damage to herself

Of the trial itself there is little to say It took place at five o'clock in the morning of July 28th The Ferret left Portsmouth harbor, and, turning round, steamed toward the boom at about fifteen knots. The lieutenant and quartermaster stood on the bridge and at the wheel respectively, and steered a course direct for the center of the obstruction When a hundred yards distant steam was shut off The surrounding pinnaces and tugs closed in the "Ferret" caught the boom between two balks—and went through it as easily as if it had been packthread No shock whatever was felt on board and everyone—engine-room staff and stokers included—remained at their posts, and were in fact, unaware of the fact that the obstruction had been cleared A glass of water left standing on the wardroom table was not even spilled

The hawsers were cleanly cut, and the two halves of the boom swung round with the tide toward the shore

The 'Ferret' could easily have proceeded into the dockyard under her own steam, but two tugs took charge of her and later in the day she was docked An examination showed that she was quite undamaged The hawsers had made a dent in her bows but no plates were started and she was making no water It is not believed that she was strained in the slightest degree, but this will not be definitely known until a thorough examination has been made

The experience was practically a repetition of what occurred in 1885 when the torpedo-ram 'Polyphemus" charged and broke a strong boom at Berehaven in Ireland In that case, however, the attacking vessel was a craft of over 2,000 tons, and the boom was not so scientifically constructed as that tested at Portsmouth

It is understood that the Admiralty intend to carry out a series of tests, with the object of discovering a really efficient obstruction for harbor mouths It is suggested that a series of wire entanglements, placed one behind the other will next be tried As was to be expected, the result of the Portsmouth trial has already led to a demand for the reinstatement of the submarine mine defenses of British harbors.

THE FIRST CROSS-COUNTRY FLIGHT OF THE AERONAUTIC SOCIETY'S BIPLANE.

As mentioned in our last issue, Mr. Charles F. Willard has been learning to fly the Curtiss biplane acquired recently by the Aeronautic Society Last week, in the vicinity of Mineola, L. I., Mr Willard made practice flights early in the morning almost daily. On the 14th instant he made a flight in the shape of the letter S of nearly five minutes' duration, in the course of which he traveled about three miles. The following morning, at 5 26 A. M., he started off as usual near the fair grounds at Mineola, but, instead of circling over the plain, he drove the machine above the fair grounds some three miles across country to Garden City At this point he turned to the left and headed for the grounds of the Meadowbrook Hunt Club, passing over a group of men on their way to work, who waved their caps and cheered From this point he flew toward Westbury, swerved to the south, and crossed the Motor Parkway, making several turns. He traveled to the outskirts of Hicksville, whence he directed his machine straight back to Mineola. Before reaching the starting point, however something about the motor gave out, and the machine was forced to descend upon rather rough ground. The landing was made without damage, however. The machine was in the air over nineteen minutes, and covered a distance of about twelve miles. The height attained was about 150 feet. This is the second cross-country flight made in the United States by any aeroplane. the first one being that made by the Wright machine in its government test on the 30th ultimo. Mr Willard traveled somewhat farther than did Orville Wright and Lieut. Foulois, though the ground over which he flew was much smoother and less dangerous in case the machine was obliged to alight This flight surpasses any ever made by Mr Curtiss himself, or by Messrs. McCurdy or Baldwin In addition to being a cross-country flight, it is the longest flight yet made in the United States by any machine other than the Wright. It is probable that further exhibition flights will be made with this machine by Mr Willard in the near future

MR. CURTISS AT RHEIMS

Mr Glenn H Curtiss arrived in France on the 12th instant with his aeroplane which was packed in boxes. The machine was taken as personal baggage directly from Havre to Rheims and after busying himself the following day with its erection Mr Curtiss announced that it was almost ready for trial This will give him a full week in which to tune up the machine and prepare for the races, which start on August 22nd There seems little doubt that Mr Curtiss's new biplane will make an excellent showing against the two score machines with which he will have to compete

THE TRIAL FLIGHT OF THE "BADDECK NO. 1"

'Baddeck No 1,' the new biplane with which Messrs. McCurdy and Baldwin are experimenting at Petewawa military camp in Canada, met with an accident when the first flight was attempted on August 13th The machine reared suddenly in the air and

(*Concluded on page 127*)

The boom consisted of 12-inch by 12-inch logs, tied together with four lines of heavy steel cable. Three feet above and five feet below the boom were stretched two 3-inch steel cables. At the front end and along the sides of each log were sharp, forwardly-projecting steel spikes. The torpedo-boat destroyer struck the boom between two logs, cut the cables, and passed through undamaged.

Torpedo defense boom before the attack in Portsmouth harbor.

TORPEDO BOOM EXPERIMENT.

A RECORD CROSS-COUNTRY MOTOR-BOAT TRIP.

BY OUR SPECIAL CORRESPONDENT.

A river trip of 450 miles made in one day between dawn and dark would certainly be a record-breaking performance. Such a trip could hardly be made with the usual type of high-speed motor boat, as neither the engine nor the hull would be likely to stand 15 hours continuous running at a 30-mile clip. The annual French endurance race from Paris to the sea, in which a number of the fastest racers usually compete, is generally run in stages, so that it lasts several days and consists of a few spurts of several hours each. When these facts are considered, one can appreciate the bold undertaking of the Dean brothers, of Cincinnati, O., when they attempted to run their fast boat "Br er Fox II" from Pittsburg to Cincinnati in one day This boat had previously made the 1,554-mile trip from St Louis to New Orleans at a speed of 29.8 miles an hour and altogether had traveled over 3,000 miles at a speed of nearly 30 miles an hour

The start was planned for Sunday, July 10th last, but on account of low water in the Ohio River it was necessarily postponed A demonstration was given the SCIENTIFIC AMERICAN representative of the speed of the boat, however, in a round trip to McKeesport, Pa., a town 20 miles distant. The running time was 39 minutes one way and 41 the other, which was against a slight current. This was an average of over 30 miles an hour Fortunately, within the next three days there was some rain, and the water rose enough in the river to make possible the undertaking of the trip, although only with the running of considerable risk, as the following account shows The start was made from the landing of the Pittsburg Launch Club on Wednesday evening, July 14th, at 7 09 25, with the intention of running through the six dams to Rochester, Pa., that night, in order to make an early start through the open river on Thursday morning, thus avoiding the loss of time in locking through these six locks. A storm came up after passing through dam No 1, and the boat was forced to tie up for the night. Another start was made early Thursday morning, and dam No 6, at Rochester, was reached at 9 25 10, the actual running time through the pools being at the rate of 25 miles per hour

Below the pools the water was found to be so shallow that it was necessary to cut out four of the eight cylinders in order to reduce the speed of the engine to 500 R. P M., or approximately half speed. Below Wellsville, O., the propeller struck the bottom of the river and was bent. It was decided to continue with the disabled propeller until deeper water was reached, as the extra propeller carried on the boat had been damaged on the trip up the river to Pittsburg. It was impossible to make any speed until Bellaire, O, a distance of 95 miles, was reached, although the engine performance was perfect. The boat grounded several times, causing a loss of considerable time, but fortunately little damage was done.

Rear view of "Br'er Fox II." traveling at high speed.

All eight cylinders were set working at Bellaire, but four were cut out again after going about two miles, and but four cylinders were used to Marietta, a distance of 171 miles. Sistersville, W. Va., was reached on Thursday evening at 6:49. The night was spent here, and a supply of gasoline and cylinder oil was taken aboard. Leaving Sistersville at 6:37:10 on Friday morning, a quick run was made to Petticoat Bar, [illegible] miles down the river. The propeller struck the bar while the boat was running nearly at full speed Two blades were stripped from the wheel, and the boat was paddled to the bank, where the other propeller was put on. The shaft was bent slightly just in front of the propeller The accident happened at 7 A. M, when all eight cylinders had been put on for a short time, as there appeared to be about three feet of water The start was made from Petticoat Bar at 8 43 40, the engine running on four cylinders, and no further changes were made until Marietta was reached at 10 22 05, where there was considerably more water owing to the Muskingum River flowing into the Ohio at that point.

Full speed was maintained until near Ravenswood 218½ miles from Pittsburg where a stop was made to replace the batteries. The boat is equipped with a magneto, but this had been disabled in the storm on Wednesday night, and was out of commission From Ravenswood to Ironton 106½ miles the engine was run at full speed continuously, and not a single adjustment of any kind was made Had it been possible to run at this rate of speed with the same amount of water down from Pittsburg, there is no doubt whatever that the run could have been made from that city to Cincinnati in one day The performance of the engine on such high speed for such a distance is nothing short of remarkable, and is a triumph for the manufacturer of the two-cycle engine No part of the engine heated up at any time, and not an explosion was missed Vanceburg, Ky was reached at 7 12 Friday evening The boat was tied up for the night, and a supply of gasoline and cylinder oil was taken on A fresh start was made at 7 22 on Saturday morning, and the run to Maysville, Ky, was made without stopping or slowing down the engine The landing at Maysville was reached at 8 38 50, thus making the 30½ miles between those cities in 1 16 50, and this with a bent propeller and shaft Such a performance by a badly disabled boat is truly remarkable and particularly when it is taken into consideration that while the "Br'er Fox II" is designed to carry a crew of but two, she carried a crew of four on this trip, and 85 gallons of gasoline instead of the 30 gallons which are generally carried

At Maysville a telegram was received from Cincinnati asking that the boat's arrival be planned and timed for one o'clock, as the launch clubs of that city had planned a reception at that hour The boat was accordingly held at Maysville until 10 49, when the start was made for Cincinnati, 60 miles distant. The engine was then run without change of speed or adjustment until the Ohio River Launch Club was reached, where ten minutes were lost in taking on an extra can of gasoline, the supply having run short. Cincinnati was reached at 1 15 45 where the boat and occupants received a rousing reception from a large crowd The run from Maysville to Cincinnati was made at the rate of 26 54 miles per hour, the fastest long run on the trip

The actual running time for the trip from Pittsburg to Cincinnati was 21 hours 35 minutes, and 25 seconds which is a new record by water between these cities. This was at an average rate per hour of 21 25 miles, a most notable performance for a disabled boat in low water where two-fifths of the entire distance was made under half power At least ten per cent additional distance was covered on this trip due to the necessity of crossing and recrossing the river in order to keep in the channel, maneuvering which would have been unnecessary had there been a sufficient stage of water to permit running straight ahead and cutting the bends and curves in the river The crew on this trip was composed of M. B. Dean, captain, William Stevenson, engineer James Rowley pilot and George D Steele representing the SCIENTIFIC AMERICAN It is the intention of Mr Dean, who is one of the owners of the Br er Fox II to make another attempt at a one-day trip from Pittsburg to Cincinnati this fall when there will be a better stage of water in the Ohio River With proper conditions there is but little doubt of his accomplishing the remarkable feat The second attempt will probably be made with another type of boat as the Fox Company is installing its 8-cylinder motor in a hydroplane craft that it is thought will prove very speedy

Side view of "Br'er Fox II" under way

The 8-cylinder 2-cycle motor

A RECORD MOTOR-BOAT TRIP FROM PITTSBURG TO CINCINNATI

The Br er Fox II was planned and assembled by Mr A G Dean, one of her owners and also one of the officers of the Fox Reversible Gasoline Engine Company of Newport Ky She is 40 feet in length 4¼ feet beam and draws about 26 inches of water The hull is of rib and carvel construction planked all over with ¼ inch white pine and weighs without engine and equipment, about 625 pounds. She is built on racing lines, and was designed and constructed by Wright brothers, of Newport, Ky

The power equipment consists of a Fox motor rated at 56 to 65 horse-power This engine is unique in that it has eight cylinders of the two-cycle type arranged in line above an 8-throw crankshaft. In appearance the motor is similar to the usual two-cycle engine excepting that the cylinders are set farther apart to permit the use of wider bearings The cylinders are all 5 inch bore by 5 inch stroke and the base is a solid one-piece aluminium casting The crankshaft is cut from a solid steel billet, and the throws are set to fire the cylinders 1, 5, 2 6, 3 7 4 8 At a speed of 800 R. P M this gives 6,400 piston oscillations per minute and results in wonderfully steady and efficient power

The one special feature of this motor is the design and location of an auxiliary fourth port, which is now being patented Through this port air is drawn into the explosion chamber slightly in advance of the incoming charge of gas, and this injection of air accom plishes the double purpose of expelling the burned gas without waste of fuel and leaving pure air in the explosion chamber instead of vitiated gas.

These fourth ports can all be operated together by means of a lever, and when opened, result in a marked increase in both power and speed. High tension ignition by means of two distributors and two coils is employed. Lubrication is effectually accomplished by a force-feed system into the journals and by a spray taken by the incoming gas to the wrist pins, connecting rods and pistons. A clutch of the self locking type is used but no reversing gear is required, since the motor is readily reversible.

As is customary with boats of this type the exhausts are open and extend several feet above the sides of the boat. These exhausts are 2¼ inches in diameter.

The motor drives a 22 inch diameter 44 inch pitch wheel at from 750 to 800 R. P. M. with ease and in short test runs has turned this wheel at from 810 to 825 R. P. M. in the Pittsburg pools giving a speed in excess of 30 miles per hour in the slight current of those pools. On the run from Pittsburg down the Ohio to Cincinnati the engine kept up a steady speed of from 750 to 775 R. P. M. without forcing and maintained this speed for hours at a time without perceptible heating. This speed could be maintained easily for an entire day or even more were the stage of water sufficient to permit the boat to run at such speed in safety.

In the run to Cincinnati, four gasoline tanks were carried: two rear tubular tanks in the stern each having a capacity of 15 gallons, one 20-gallon tank under the seat, one 30 gallon tank in front of the seat, and one 5-gallon gravity feed tank directly over the 30 gallon tank, making a total capacity of 85 gallons for long runs. The tanks all feed into the 5-gallon gravity tank, a hand pressure pump forcing the contents of the lower ones to this gravity tank. Besides an individual carbureter for each cylinder the transfer pipes of each pair of cylinders are connected to a second carbureter so that there are no less than 12 carbureters used on the engine.

Based on rated power the motor in the "Br'er Fox II" consumes approximately 1.4 pints of gasoline per horse-power hour, but the engine unquestionably delivers more than its rating, so that on actual wheel performance turning a 22 inch diameter 44 inch pitch wheel 800 R. P. M. it is very close to a pint per horse power hour.

The boat has a capacity of 14 gallons of cylinder oil in tanks. She is designed to carry two men averaging about 155 pounds each and 30 gallons, or about 240 pounds of gasoline. On the trip from Pittsburg to Cincinnati she carried four men whose combined weight was 670 pounds and 85 gallons of gasoline, weighing approximately 600 pounds, or a total of 1,270 pounds against 550 pounds which is her estimated capacity when speeding.

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The Current Supplement.

The opening article of the current SUPPLEMENT No. 1755 is devoted to a discussion of the wonderful Frankfort Aeronautical Exposition which has been opened with such success in Germany. Excellent views of the exhibits accompany the text. Mr. E. F. Lake's exhaustive and instructive article on the oxhydric process of cutting metals is continued. Mr. Newton Wright explains how the size of gas and oil engine cylinders may be determined. It is a curious fact that many of the marbles employed by the Romans, Greeks and even Egyptians are those most highly valued by the architects and builders at the present time. Marbles and other decorative stones from the identical localities which were sought by the ancients with so much care are now to be seen in most fine modern buildings in London and other cities. This whole subject of ancient marbles and ancient marble quarries constitutes the subject of an article by Mary W. Porter. O. Bechstein contributes a wonderfully instructive article on kieselgur and its uses. The experimental evidence in support of the atomic hypothesis is set forth by R. Ehrenfeld. Maria Parloa's monograph on canning and preserving fruit is continued. Interesting electrical notes are those entitled "How to Join Electric Wires" and "The Egner Holmstrom Telephone Apparatus." It is sometimes necessary when designing buildings or other works to construct models in order to explain intricate points more clearly than can be shown in drawings. How this is done Mr. Stanley C. Bailey explains. Improved deep-sea sounding apparatus is described by Capt. E. Moll. A report of the Sixth Conference of the International Commission of Meteorology is published. A calendar good from 1763 to 1962 is not the least interesting feature of this issue.

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From the returns compiled by Lloyd's Register of Shipping it appears that excluding warships, there were 308 vessels of 745,705 tons gross under construction in the United Kingdom at the close of the quarter ended June 30th, 1909.

Correspondence.

THE NUMBER OF OUR ANCESTORS

To the Editor of the SCIENTIFIC AMERICAN:

The difficulty that some of your correspondents have with the ancestral puzzle is in disregarding the marriage and intermarriage of distant relatives. Thus if one of B's grandparents on his mother's side was cousin to one of his grandparents on his father's side, B would have only 14 great-great-grandparents. The one divergent series would be extinguished and the number of his ancestors in any one generation would be $2^n - 2^{n-4}$. If, instead, two of his eight great-grandparents were cousins the formula would be for any generation $2^n - 2^{n-5}$. If there were two sets of cousins among his great grandparents the formula would be $2^n - 2(2^{n-5})$, etc.

When we consider that our ancestors for hundreds and thousands of years lived in small and more or less isolated villages and communities and that families of as many as ten or twelve children were not uncommon, we can see that could we trace all lines of descent of any one person we would find them constantly running into each other and merging into common ancestors. Thus in the fifteenth generation we might trace descent from two parents through any one or through all of their twelve children. And if the blood of these children had commingled at other times in the line of descent, as it must at least in an isolated community, two persons in the fifteenth generation might represent a hundred or even several thousand of B's theoretical ancestors.

Nora Springs, Iowa. W. A. ECKLES.

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THUNDERSTORMS

To the Editor of the SCIENTIFIC AMERICAN:

The explanation of thunderstorms ordinarily given is that clouds are formed of minute particles of moisture, each having an electric charge on its surface. These particles agglomerate in drops of rain and their electric charges spread over the surface of the drops with a resulting greater electric density because the surface of a drop is much less in extent than the aggregate of the surfaces of all the particles of which it is made, the increase in surface being proportional to the square of the diameter, when the increase in volume is proportional to the cube of the diameter. For instance the electric potential (depending on the electric density on its surface) of a drop of rain ⅛ of an inch in diameter will be 125 volts, if it is formed of particles 1/1,000 inch in diameter whose potential is one volt.

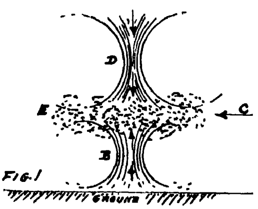

FIG. 1

The drops of rain in a cloud being separated by air acting as a dielectric, electrify each other by influence, the resulting influence at the center of the cloud being an enormous electrostatic strain, which is relieved by lightning.

This simple explanation is that generally given in the lecture room but is not sufficient to explain the thunderstorms without rain frequent on the Western plains in hot dry weather. The writer has observed many in northwest Texas. One day at noon I was resting in my house, when I was startled by a sudden clap of thunder followed by others. I had not seen a sign of a cloud a few minutes before when coming home. Stepping out doors, I saw toward the zenith a very thin yellowish cloud somewhat broken, from which emerged the thundering. No lightning could be seen, the glare of the sun through that misty cloud being too intense. From its rapid motion and the distinctness of the claps of thunder I judged that it could not be very high. This phenomenon lasted about three minutes and vanished.

The appearance of that cloud was unusual for a dry thunderstorm. Ordinarily, in such occurrences there are several scattered small white clouds, embryo cumuli in shape but diaphane, they look "dry," and do not cast any appreciable shadow on the ground. They appear and vanish with more or less sharp thunders seemingly at a high elevation. No lightning can be seen because of the sunshine through them. These electric discharges begin about noon, to last until about two hours before sunset. During the day there are occasional flashes of breeze, but no continuous wind in a certain direction.

This condition of weather may last without rain for two or three weeks, and is generally followed by a stubborn drought, with a smoky appearance of the sky and very little or no dew in the morning. The absence of rain, the small size of the clouds, and their diaphane, evanescent appearance, indicate that other agencies besides those mentioned in the lecture room are active for the presence of electric potentials widely differing in a dry thunderstorm.

Observations have shown that the electric potential of the air increases with the distance from the ground. Now suppose that a portion of the upper atmosphere be brought near a portion of the nether atmosphere within a medium like mist, where electrification by influence can take place, the requisites for an electric discharge are present and apply to dry thunderstorms. They occur when atmospheric conditions are favorable for causing local ascending currents of warm air with a small quantity of aqueous vapor to an elevation where they meet a cold current, whose cooling effects contract the hot air and condense the vapor it contains, creating a vacuum that sucks the air from the highly electrified upper atmosphere as shown in Fig. 1, where *B* is a warm ascending current, *C* is the initial cooling current (which has disappeared), *D* is the descending current, and *E* the cloud formed by the condensation of the vapor in the ascending current *B*.

From the absence of rumbling thunder the electric discharges seem to be confined within each separate cloud and originate mainly from differences of potential brought from different strata in the atmosphere.

The ordinary thunderstorms with rain happen also when atmospheric conditions cause ascending currents of warm air containing aqueous vapor. There is low barometer and a preceding period of calm high temperature, the clouds are cumuli and pile very high up, especially for hailstorms.

When rain is brought by a wind that has been blowing for a few hours or days in the same direction, the clouds are of the nimbus class, they overcast the whole sky, and though the drops of rain may be large, there is no appreciable thunder and lightning, the electric potential being too uniformly distributed throughout the cloud.

Pittsfield, Mass. HENRY GETAZ.

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THE EFFECT OF POLAR CURRENTS ON GULF STREAM PLANKTON

To the Editor of the SCIENTIFIC AMERICAN:

It was announced some time ago that very interesting communications were to be published shortly from the pen of Prof. Frithjof Nansen and assistants upon the most recent results of the investigations which have been carried on for a series of years with a view to ascertaining the influence which the water in the polar currents has upon the water in the Gulf Stream in the way of creating very favorable conditions of existence in the latter for plankton and higher marine life.

The results may be shortly summed up thus: From the investigations carried on during the "Fram's" voyage across the north polar basin it has been proved conclusively that in the polar water which is protected by a thick layer of ice from the influence of light, accumulate matters which have a fertilizing effect upon the vegetable life in the open sea and which in the cold, dark polar water are not used. The polar basin is like a large tract of fallow land in which fertilizing matters accumulate without being used.

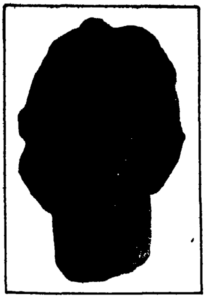
The warm water in the Gulf Stream on the contrary, when reaching the northern part of the Atlantic is desert water so to say. It has been used up and contains only scanty means of subsistence for any animal life.

The more polar water that sets in and mixes with the warm water in the Gulf Stream, the more luxuriant seems to be the growth of plankton and higher marine life. It is the cause of colder summers in northern Europe, but the fisheries seem to be better in proportion.

The results of these investigations, of which only a short summary is just published in the press, will be issued in book form, and seem to open up prospects of our being able to foretell good or poor fisheries and to explain many interesting phenomena which seem to be dependent upon the temperature in the northern part of the Gulf Stream.

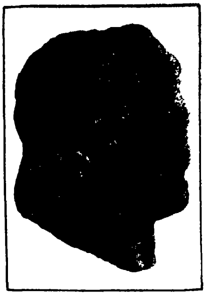
Christiania, Norway. J. A. MÜNCH.

Rubber Substitute.—According to a foreign patented process, a substance resembling rubber or gutta percha is produced by mixing gelatine, bichromate of potash, and glycerine, and molding the mass obtained. The components are used in an anhydrous state, to retard the working of the bichromate of potash on the gelatine; by heating, the chemical effect may be increased or reduced.



THE EXCAVATIONS AT DELOS

BY THE
PARIS CORRESPONDENT
OF THE
SCIENTIFIC AMERICAN



In 1908 excavations in the island of Delos were begun on an extensive scale, owing to the liberality of the Duc de Loubat, who decided to make an annual gift to the enterprise of $10 000 in order that the work could be carried on in a manner which is justified by the great importance of the site The work is carried on by the French School of Athens and M Homolle, whose connection with the excavations at Delphi we have already had occasion to note, directed the first part of the enterprise Since then it has been carried on by his successor M Holleaux and various archæologists of the French School Because of the great number of discoveries which have been made at Delos the archæological world is much indebted to the action which the Duc de Loubat took in aiding the excavation work

From an early period going back to the eighth century B. C Delos was a center of the worship of Apollo who had a celebrated sanctuary on the island After passing through many political vicissitudes, Delos was completely ravaged by the army of Mithridates. Its most flourishing period appears to have been in the third century B C

Since Delos was a religious as well as a commercial center it is but natural that we should find remains both of various temples and also of extensive buildings such as storehouses and wharves In general, we may liken the site of Delos to Pompeii, because it is covered with remains of public and private buildings But naturally it is far superior to Pompeii in the artistic character of the structures and other remains, for here is represented a flourishing period of Greek art. For this reason the excavations at Delos are of especial interest and the remains have a high artistic value. On the one hand we have specimens of sculpture which belong to the principal epochs. There are also extensive remains of architectural forms, columns etc. Not the least in importance are the fragments of mural decorations which are found in various places While these are not in so good a state of preservation as those of Pompeii they give a clear idea of the decorative borders friezes and large wall paintings that adorned the larger dwelling houses of Delos Mosaics of brilliant colors are also found and some of these are in a good state of preservation

The excavation work is carried on with a view to clearing as much as possible the streets and edifices of the site In the quarter of the port, very extensive wharves have been disclosed as well as large quays and storehouses, evidences of considerable commercial activity It is evident from their extent that Delos was one of the most important commercial ports of the archipelago

As regards the work which has been undertaken at Delos since 1903, the year when the Duc de Loubat came to the aid of the enterprise it is one of the most considerable to be carried out in Greece, so far as the amount of material is concerned This is no less than 50,000 cubic yards of earth annually As the various walls were brought to light they were consolidated to keep them together and efforts were made to preserve the stucco decorations and mural paintings. The appearance of the paintings, mosaics, and various decorative *motifs* is shown in a collection of water-color drawings which were made on the spot by two artists belonging to the expedition

Among the points which have been explored up to the present are the sacred inclosures in which was the leading sanctuary of Delos, also the quarter of the Theater Near the inclosure is the sacred lake, a small body of water One of the most remarkable finds is a tomb belonging to the Mycenæan epoch, to which we may assign a date between the twelfth and the fifteenth century B. C. Thus we remark the great antiquity of the early remains of Delos, showing that it flourished at even this remote period On this spot were found fragments of pottery which are of value in the study of this epoch A great terrace or esplanade was uncovered near the sanctuary Here were found five colossal lions which were set up in a range and spaced at equal distances apart along the terrace One of our engravings shows the appearance of this site and another one represents one of the lions, showing the considerable size and also the great antiquity of the specimens. They rank in date after the above-mentioned tomb, and from their archaic character we may place them in the seventh century B C M Salomon Reinach however, considers that the group of lions may have been offered to the sanctuary by Crœsus, King of Lydia, fabled for his riches. He bases his theory on the fact that Herodotus states that Crœsus had offered a massive gold lion to the temple of Delphi having a weight of ten talents the lion being the ancestral sign of the king s family It is possible, therefore that the group at Delos may have come from the same source and this would place them in the sixth century

Coming to the remains of a later epoch we find a street which led from the theater to the sanctuary a very narrow street only five feet wide It was bordered with small houses and shops and must have been much frequented

As to the general character of the excavations at Delos as they appear at the present time one of the accompanying views will give a good idea of the extent of the work It will be observed that it covers a very wide area. Like modern buildings in some countries the dwellings of Delos consist of a central court surrounded by a portico with columns opening into which were the various rooms of the building Some of the columns in this and other structures of a like character are in a good state of preservation and the walls in some cases are high The remains slightly resemble the dwelling houses at Pompeii One of the dwellings, which has a considerable interest is similar to the above and is known as the "villa of Cleopatra" Here the portico is upheld by high Doric columns. There were found here the statues of the owners of the villa, Dioscourides and his wife Cleopatra (who has of course no relation to the Queen of Egypt) The latter statue which is shown here is in a good state of preservation although the head is unfortunately missing. An inscription on the statue relates that Cleopatra, native of the town of Myrrhinonte in Attica, executed the statue of her husband which is the accompanying one and that he himself had offered two silver tripods to the temple of Apollo As the inscription bears the name of the archon Timarchos, we are able to fix the date of the statue in the second century B C The draped statue retains some of the characteristics of the grand epoch in its treatment.

* * *

A NEW APPLICATION OF THE DIVING BELL.

BY THE GERMAN CORRESPONDENT OF THE SCIENTIFIC AMERICAN

A remarkable diving bell or portable caisson has recently been constructed for the German Navy Department for use in the deepening of the harbor of its naval base at Tsingtau The remarkable features are not so much those of the bell itself but of its connection with the imposing structure above water shown in our frontispiece, the whole making a complete and self-contained unit for excavating to a maximum depth of 15 meters below water level

Two pontoons, each 16 5 meters long 5 6 meters wide, and 2 2 meters deep, are rigidly braced together bow and stern forming between them a well into which the diving bell may be completely withdrawn from the water Upon the deck of the joined pontoons is erected the superstructure, from which the diving bell is suspended and operated consisting principally of conventional I-beams and angles.

The diving bell is built of sheet iron externally braced, and is 10 meters long, 5 meters wide, and 2½ meters high Extending upward from the top of it are three telescopic shafts, two for the hoisting of the excavated material each 80 centimeters in diameter, through which a bucket of 1 ton capacity can pass, and one of 1 meter diameter for the workmen Each of these is provided with such an air lock as is now familiar in connection with tunnel and foundation work in New York and elsewhere in which as workmen enter the air pressure is gradually raised from that of the atmosphere to that required to exclude water and mud from the interior of the caisson being similarly reduced for those ascending from work The air locks of the spoil shafts are identical but the air may be compressed or exhausted much more rapidly in the hoisting of buckets of excavated material the gradual change of pressure being necessary in the case of men only as a precaution against caisson disease

The bell is suspended by four sets of chain tackle, one at each corner which are mounted on opposite ends of two shafts on the operating platform of the superstructure driven simultaneously by an electric motor when it is desired to raise or lower the bell

Higher platforms carry two cranes which receive the buckets of excavated material from the top of the spoil shafts and deliver them into scows alongside or however desired the cranes also being electrically driven as are the winches inside the spoil shaft for hoisting the buckets from the interior of the bell One man on the platform at the top of each of the latter can hoist the bucket with the winch detach it, and hook it onto the crane and *vice versa* and also raise and lower the bell as desired Two more operators for the cranes above are required

On the deck are three compressors supplying the necessary air pressure to the interior of the bell power for the whole equipment being supplied from a stationary plant on shore Both the superstructure and the interior of the bell are electrically lighted and communication is maintained between them and from either to the shore by telephone Quarters for the crew are provided in the interior of the pontoons

The design of the superstructure permits of continuous operation being carried on independently of the varying height of the pontoons due to rise and fall of tides.

* * *

THE FIRST CROSS-COUNTRY FLIGHT OF THE AERONAUTIC SOCIETY'S BIPLANE

(*Concluded from page 12?*)

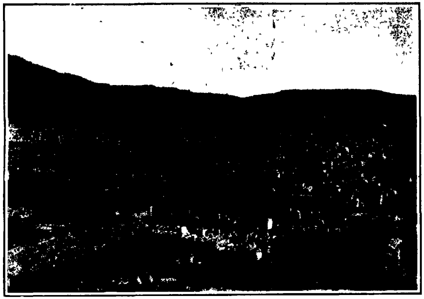
fell backward breaking the rudder and propeller and damaging the running gear Mr McCurdy the aviator was unhurt and the engine was not damaged The accident is said to have been due to the engine being placed too far to the rear The machine will be repaired in about a week when further flights will be attempted

M SOMMER'S RECORD FLIGHT

The record endurance flight of 2 hours and 27¼ minutes in France mentioned in our last issue was wrongly attributed to M Gaudart This flight was made by M Roger Sommer with a Farman-type biplane and although unofficial it is probably the longest ever made with an aeroplane

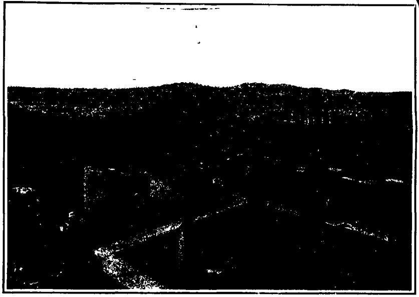
* * *

In an article appearing in the American Machinist on annealing high-speed steel the author states experiments have been carried on looking to electrical annealing and to bright annealing by immersion in a bath of fusible metallic salts somewhat after the manner of the barium-chloride process for hardening Moderately successful results have in some cases been obtained, but the methods are not as yet sufficiently developed for commercial use The two methods have also been combined with results apparently good the salts bath being heated by the passage through it of a low-tension electric current



The central portion of the sanctuary

Hellenistic bas-relief.



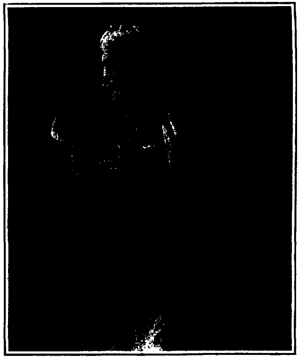
A house in the quarter of the theater

Statue of Cleopatra

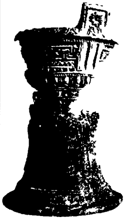
Group representing Aphrodite, Pan, and Eros (2 B. C.)

One of the lions—possibly dedicated by Croesus.

The terrace of lions.



Statue of Silenus.



Terra-cotta heating pan

SOME RECENT REMARKABLE DISCOVERIES AT DELOS.

CONJUNCTIONS OF THE PLANETS.

BY PROF FREDERICK R. HONEY, TRINITY COLLEGE.

The purpose of this article is to treat of only that part of the general subject of planetary configuration which relates to a comparison of the planets when they have the same right ascension, i. e., when they are on the same celestial meridian.

Six conjunctions of the planets occur during the latter half of the present year. One illustration is a plot of the orbits of the terrestrial planets, showing the positions of the earth and of the planets at each conjunction. The other shows the apparent diameters and phases magnified. In order to compare the figures they are all drawn to the same scale. The apparent distance between the planets at each conjunction however cannot be represented on this scale because the figures would be separated by a measurement which would fall beyond the limits of the drawing, but the distance seen by the naked eye, is given in the text. The date of conjunction is Washington mean time.

CONJUNCTION OF MERCURY AND NEPTUNE

July 23d 0h. The distance between the planets is a little more than twice the moon's diameter which subtends an angle of about ½ deg. Neptune's diameter is nearly eleven and one-half times the diameter of Mercury (= 34800/3030). At this date Neptune's distance *from the earth was about thirty-one times* the mean distance between the earth and the sun (= 30.9 × 92.9 million miles), while Mercury's distance was only one and one-fifth times this unit (= 1.195 × 92.9 million miles). The apparent diameter of a planet is proportioned to its true diameter and inversely as its distance from the earth. The result of a simple computation shows that Mercury subtended a very much larger angle than Neptune.

The plot shows that the planets are morning stars and that Mercury's phase is gibbous. In this and in the illustrations which follow, the arrow drawn with the full line shows the direction of the planet as seen from the sun, and that drawn with the dash line as it is seen from the earth. On account of the great distance to Neptune the convergence of these visual rays is scarcely perceptible in the drawing.

CONJUNCTION OF VENUS AND JUPITER.

August 11d 14h. Jupiter and Venus are evening stars. The former is daily receding farther from the earth and will be in conjunction with the sun on September 17th after which date Jupiter will be morning star. Venus presents the gibbous phase, and at the time of conjunction the relative diameters of the planets appear as shown in the illustration. The computations for *these figures are similar* to those which have been explained. The great difference between the equatorial and polar diameters of Jupiter are apparent. The planets are separated by a distance equal to two fifths of the moon's diameter.

CONJUNCTION OF MERCURY AND JUPITER.

August 24d 19h. The planets are evening stars and are at a distance apart equal to one and a third times the moon's diameter. Mercury shows the gibbous phase the dark edge being opposite from that shown on July 23rd.

CONJUNCTION OF VENUS AND URANUS

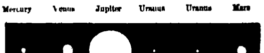
November 23d 8h. The planets are evening stars and may be seen a long time after sunset. Venus is rapidly approaching the earth and as a consequence the planet's diameter is increasing. An inspection of the plot shows that a little more than one-half of the illuminated surface is visible. Venus will soon present the half moon phase which will be succeeded by the crescent phase when she will be the most beautiful object in the evening sky. The planets are separated by a distance equal to about five times the moon's diameter.

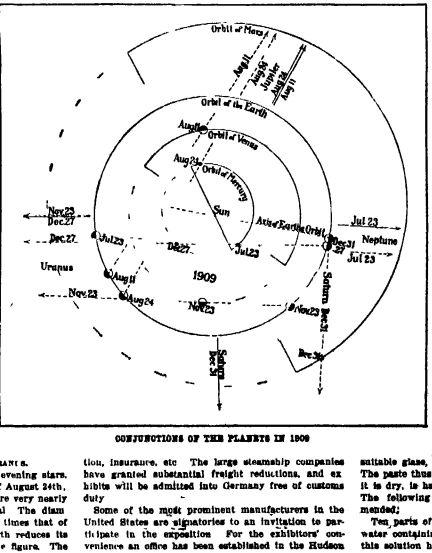
CONJUNCTION OF MERCURY AND URANUS.

December 27d 15h. The planets are evening stars. Mercury shows the same phase as that of August 24th, and since the distances from the earth are very nearly equal the apparent diameters are equal. The diameter of Uranus is about ten and a half times that of Mercury but its distance from the earth reduces its apparent diameter to that shown in the figure. The distance separating the planets is equal to about three and a half times the moon's diameter.

CONJUNCTION OF MARS AND SATURN

December 31d 2h. Again the planets are evening stars. Mars shows the gibbous phase and his distance from the earth is about equal to that between the earth and the sun. The apparent distance between the two planets is nearly six and a half times the moon's diameter. The great difference between the equatorial and polar diameters of Saturn is very apparent. Although Jupiter's diameter is scarcely one and three-sixteenths times that of Saturn, the diameter of the latter is very much reduced on account of its greater distance from the earth.





CONJUNCTIONS OF THE PLANETS IN 1909

* * *

An American Exposition in Berlin in 1910.

What promises to be a unique event in international commerce will take place under distinguished auspices in Germany's capital next year.

In a recently erected permanent exposition building known as the Exposition Palace near the Zoological Gardens, in the best section of Berlin, an exposition of American products exclusively, among which tools and machinery will form an important part, will be held during the months of April, May, and June, under the patronage of Prince Henry of Prussia.

This exposition is designed to stimulate and strengthen our trade with Germany a trade the importance of which may be gaged from the statement that Germany bought nearly $277,000,000 worth of goods from the United States in 1908 and is America's second best customer. Prominent men on both sides of the Atlantic will co-operate to make the undertaking a success.

The exposition commends itself particularly because of the fact that there will be no drudgery connected with it for the exhibitors. The space rental will include all incidentals such as the decoration of the booths, foundations for the exhibits and carpeting janitor service the storing of the packing material, protection, insurance, etc. The large steamship companies have granted substantial freight reductions, and exhibits will be admitted into Germany free of customs duty.

Some of the most prominent manufacturers in the United States are signatories to an invitation to participate in the exposition. For the exhibitors' convenience an office has been established in the Hudson Terminal Building, New York city.

* * *

The 'Parahyba,' the sixth of the ten destroyers ordered by the Brazilian government from Yarrow & Co Limited, of Scotstoun, ran an official full-speed trial a few days ago on the Skelmorlie mile. She attained a speed of 27.29 knots.

Poisonous Honey.

BY PROF. KARL SAJO.

Illness, and even death, are sometimes caused by eating natural honey, free from all adulterations. The writer is not aware that any fatal cases of poisoning have occurred in Europe. They are reported exclusively from America and Asia. Almost all cases are caused by the use of honey derived from the flowers of plants of the Alpine rose and heath families (*Rhodoraceæ* and *Ericaceæ*). The matter is somewhat puzzling, because cases of severe poisoning are very rare. For example, the American cases, which are attributed to *Kalmaia angustifolia* and *K latifolia*, are only two in number, although these plants are common in America. Even in Europe, illness is sometimes produced by eating honey. I have myself witnessed several mild cases, one of which appears to throw some light upon the subject. Some children, who were watching their teacher cleaning honeycomb, asked him the nature of the dark and acrid paste with which some of the cells were filled. The teacher explained that this was bee bread. The children asked if it was fit to eat, and the teacher carelessly answered, "yes." The children ate the bee bread freely despite its unpleasant taste, and all became extremely ill.

The reader doubtless knows that bees fill certain cells partly with pollen, which is necessary food for the *development of the young bees*, as it contains albumenoids, while honey contains only carbohydrates. This pollen is known as bee bread. It is usually stored in certain special groups of cells, which can be easily separated from the honey cells. Sometimes, however, the bee keeper, to his disgust, finds in the honeycomb, intermingled with the honey cells, many cells which contain pollen. Often the lower part of a cell is filled with pollen, and the upper part with honey. In the case above cited, the poisoning was evidently due to the pollen, for persons who ate the honey from which the bee bread had been removed experienced no ill effects. I know, from personal experience, that the eating of honeycomb which contains bee bread often produces unpleasant symptoms and loss of appetite.

Several possibilities suggest themselves. The pollen may be naturally poisonous, for many pollen grains contain toxines, as was proved by Prof Dunbar in his investigation of the cause of hay fever. It is possible also that the pollen stored in the cells may become decomposed and thus produce disease germs and poisonous substances. If the bees wish to preserve their stores of pollen, which are not usually protected by large additions of honey they are obliged to add large quantities of a secretion containing formic acid, and it is not impossible that, in this operation large doses of the alkaline poison of their stings may also be added.

In view of these facts, it appears probable that the cases of poisoning attributed to honey are really caused by pollen. If this is true, the frequency of such cases should be diminished by modern methods of bee keeping in which a compartment of the hive is reserved exclusively for honey, and the bee bread is almost entirely deposited in cells attached to the broodcomb, in another compartment. Furthermore honey is now seldom pressed from the comb, but is almost entirely extracted by centrifugal separators, in which the semi-liquid honey flows out of the cells, leaving the more solid bee bread behind. In the case of honey in the comb, the presence of bee bread cells is easily detected by inspection or by the taste, and a little care in removing them will prevent any evil consequences.—Translated from Prometheus.

* * *

Washable Water-Color Paint.

Washable painting in water colors can be executed by mixing the pigments with plaster a fusible salt, a suitable glaze, and an acidulated solution of gelatine. The paste thus formed is applied like paint and, after it is dry, is hardened by heating the painted objects. The following proportions and method are recommended:

Ten parts of glue are dissolved in 100 parts of hot water containing a little acetic or other acid. After this solution has cooled it is rubbed up with 5 parts of plaster, 5 parts of soda, potash or borax, 30 parts of lead oxide or zinc white, and the necessary quantity of the water color pigment desired. The coating, when dry, is heated by means of an alcohol or other smokeless flame. The finished coating resembles enamel. It is not affected by rain or heat and may be lacquered without difficulty.

A NOVEL SOLUTION OF THE PROBLEM OF TELEPHOTOGRAPHY.

BY DR. ALFRED GRADENWITZ.

Many inventions have recently appeared for the telegraphic transmission of handwriting, drawings, and photographs. Ingenious though they be, nearly all of these devices have never passed the experimental stage, which circumstance is partly due to the extraordinary sensitiveness and complicated construction of the mechanism employed. The main difficulty met with in solving this interesting problem, however, lies in the means of obtaining and maintaining a perfect agreement between the working of the transmitting and receiving stations. In fact, an accurate reproduction cannot be obtained except by causing identical parts of the original and reproduced pictures to pass at equal times in front of a given point. On the other hand, the two picture rollers should perform their respective motions in equal intervals of time.

These difficulties, it is claimed are successfully overcome by the "teleautocopist" an apparatus recently invented by Laurent Sémat and constructed by F Ducretet and E. Roger of Paris. Moreover the machine is well adapted for the transmission of musical notes, shorthand records, prints and—a matter of especial importance for the criminal police—sketches or anthropometrical data.

The roller used at the transmitting station has a larger diameter than the receiving roller A motor which requires no superintendence is used to actuate both Different in diameter and accordingly different in peripheral area, the rollers, nevertheless, reproduce a picture exactly the size of the original

On the smaller roller of the transmitter (represented in Fig 1) is wound a metal foil on which the picture to be transmitted is drawn or printed The style which touches this foil serves to throw into the circuit the current impulses that will reproduce the picture Whenever a conducting portion of the metal foil is struck the circuit is closed, and on passing over an ink-coated portion the circuit is opened

On the larger roller (at the receiving station similar to Fig 1) is wound a sheet of carbon paper and upon this, a sheet of ordinary paper Assuming the difference in the peripheral areas of the two rollers to be ⅛ the reproduction of the original picture on the larger roller will take up only ⅞ of its peripheral area. The peripheral speeds of the two rollers are chosen at the opposite ratio of their peripheral areas that is, the smaller roller performs a full revolution in ⅞ of the time of revolution of the larger one. Again, the first-named roller after completing one revolution, is stopped and is not started again until the other roller has moved on through the disengaged eighth of its peripheral area. The process is repeated with each revolution When starting from a given point, the two rollers are accordingly seen to pass in front of the style at equal times through equal lengths of their peripheral area the longitudinal displacement is identical on the two rollers in the reproduction of original dimensions In order however, to reproduce in a magnified or reduced size, the relative diameters and displacements of the rollers are proportionately altered

Besides the advantages afforded by the simplicity and perfection of synchronism the Sémat apparatus dispenses with any selenium cells and photographic views, all operations being performed in full daylight, merely by means of mechanical devices. No special knowledge is required for adjusting the apparatus, which is readily connected with any ordinary telegraph or telephone line.

The speed of transmission is easily raised to five minutes in the case of pictures measuring 7 x 12 centimeters.

The inventor, who is an official of the Egyptian railways, has recently made some successful experiments on this apparatus, at the Khedival Palace at Cairo when the telephotographic record reproduced herewith was obtained. The apparatus was then installed at the annual exhibition of the French Physical Society and there demonstrated

The mechanism for obtaining accurate synchronism comprises an armature which arrests a peg fixed to the transmission roller as long as its electromagnet is excited At the receiving station is installed an interrupter, which opens the current each time it is struck by a cam rigidly connected with the roller

As the speed of rotation of the (smaller) transmission roller is higher than that of the (larger) receiving roller, the former, after each revolution, is arrested by the armature striking the peg until the large roller (which turns at a correspondingly lower speed), by interrupting the circuit, allows the electromagnet to relieve its armature and accordingly the stop

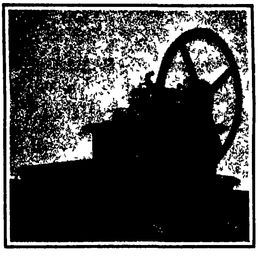


Fig. 1.—View of the transmitting apparatus, identical in appearance with the receiving apparatus

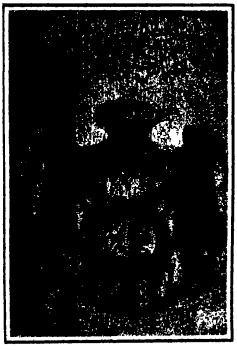


Fig 2 — The Egyptian Khedival insignia transmitted by the teleautocopist

Fig 3.—Portrait of Arago transmitted by the teleautocopist

A NOVEL SOLUTION OF THE PROBLEM OF TELEPHOTOGRAPHY

* * *

Cement from Blast-Furnace Slag.

Cement is made from blast furnace slag by various methods Among the newer processes are the following

Canaris Process.—The slag is granulated in a milk of lime made from freshly-slaked lime in a vessel provided with a stirrer Two parts by weight of anhydrous lime (CaO) are employed for each 100 parts of slag

Collosseus Process.—Slag in the fused state is treated with solutions of salts of calcium magnesium or aluminium. The action is twofold The physical structure of the slag is altered and chemical changes are effected by which the injurious ingredients especially sulphur are made harmless and even conducive to proper setting and hardening

Muller Process.—For certain purposes it is advantageous to substitute salts of barium or strontium for the salts of calcium etc

Grau Process.—A jet of dry superheated steam is projected upon fused slag in such a manner that the slag falls in the state of powder and forms a pile which is allowed to cool slowly in order to prolong the effect of the heat and steam

* * *

The new process of Dr Ekenberg for converting raw peat into fuel is based on the fact that after the peat has been heated in the presence of water to 150 deg C. about 90 per cent of the water in the peat, which ordinarily cannot be separated by mechanical means, can be removed by moderate pressure By then applying a small amount of artificial heat a fuel free from water can be obtained.

Soaps for Removing Spots.

Many soaps sold as spot removers are ordinary cocoanut oil soaps, and remove only the spots which are prepared for the purpose by the vendor For example, spots made by daubing cotton goods with a mixture of tar and acid can be removed with pure water and completely disappear when washed with ordinary soap True spot removing soaps contain ox gall and turpentine which can be detected by their characteristic and powerful odors, even if the soaps are scented

A good spot removing soap may be made by mixing 20 parts by weight of good hard white soap in very small pieces with 8 parts of water and 12 parts of ox gall The mixture is allowed to stand over night and is then heated gently until solution is complete The heating is continued a little longer in order to evaporate some of the water and ½ part of oil of turpentine and ¼ part of benzine are stirred in after the vessel has been removed from the fire The still liquid soap is then colored with a little ultramarine green dissolved in ammonia, and is poured into molds which are at once covered

The following process is also recommended but it requires some care as the soap is easily separated by agitation, especially if the ox gall is not fresh In a vessel heated on a water bath 28 parts by weight of cocoanut oil are thoroughly incorporated with 5 parts of talc or fuller's earth 1/10 part of brilliant green and 1/50 part of ultramarine green The mixture is allowed to cool to 90 deg F 14 parts by weight of lye of a strength of 38 Baumé are then added and, after saponification is completed 5 parts of ox gall are stirred in If any separation takes place the vessel is closely covered and heated on the water bath until the mixture becomes uniform Finally ¼ part of turpentine and about 8 parts of benzine are added and the soap is poured into molds

* * *

Natural Synthesis.

In an address to the chemical congress recently held in London Prof Paterno of Rome called attention to the evolution which is taking place in the synthetical processes employed in the commercial production of organic chemical compounds There is a tendency to substitute for the crude tedious, and complex methods hitherto used processes of an entirely different character in which the desired chemical changes are effected at ordinary temperatures without the employment of violent reagents. As chemical science develops it allows an approximation to the ideally perfect methods of synthesis by which nature produces vast quantities of compounds in infinite variety Duclaux has wittily rallied those chemists of to-day whose ambition and efforts are wholly directed to the comparatively easy production of new compounds even if these compounds serve no other purpose than to enlarge dictionaries of chemistry Manufacturing chemists will assuredly discover and utilize new and more natural methods of synthesis The researches of the past half century in connection with ferments microbes toxines diastases catalyzers and the colloidal state of matter have indicated very interesting possible applications of these agencies to the processes of technology Some of these agencies have long been known Many kinds of fermentation for example have been utilized from time immemorial but the mechanism of their action was unknown Now that it is better understood it is safe to predict that the practical employment of that action in chemical synthesis will soon follow Very important applications of this newly acquired knowledge of biological chemistry have already been made Yeast which only converts sugar into alcohol and carbon dioxide has been to some extent, displaced by mold fungi which also convert starch into sugar Agricultural experiments have demonstrated the great fertilizing power of infinitesimal quantities of catalyzers, and a new and valuable method of saponification has been devised by Dr Nicloux

* * *

Electrical illumination will be a great feature of the Hudson Fulton Celebration from September 25th to October 9th Over a million incandescent lamps 10 000 arc lamps, and searchlights aggregating 1 800 000 candle-power will be used in addition to the regular lighting of the city in New York alone not to mention the illumination of the Jersey shore and numerous special advertising signs.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

GARMENT-RACK.—FANNIE WOLF, New York, N. Y. This invention relates to improvements in garment racks, and more particularly to the means employed for supporting the hangers and permitting of their rotation to expose the garment to view from all sides. The invention involves features of construction substantially the same as certain of the modified forms illustrated in a prior application filed by F. Wolf.

Electrical Devices.

INSULATOR FOR THIRD RAILS.—L. STEINBERGER, New York, N. Y. Among the many objects of this invention may be named the provision of means whereby a movable portion of the insulator may be connected with the rail and so arranged as to turn relatively to a stationary portion of the insulator, the means for securing the insulator to a separate base, thus enabling the operator to handle the entire device as a single unit, and mechanism for taking up pounding action otherwise taking place between insulator and base owing to the alternate depression and rebounding of a cross tie when a train passes over it.

CIRCUIT-CLOSER.—O. M. TURTISON, Bainbridge, Ind. The main purpose here is to provide a closer which can be operated only by a special key and which therefore is not capable of being operated by any one other than the possessor of the key. The actuating member is held securely in place while it is in use, thereby rendering it impossible for a separation of the circuit closing contacts.

CONTROLLER.—H. SMITH, Suffern, N. Y. The more particular object of this inventor is to provide a type of controller in which there is a revoluble drum carrying resistance windings upon its periphery, these windings being adapted to dip into a body of free mercury and being movable at will by aid of the drum for the purpose of varying the ohmic resistance of the windings.

Of Interest to Farmers.

STALK CUTTING ATTACHMENT FOR VEHICLES.—R. B. HUMAN, Chickasha, Okla. The cutting attachment is complete in itself in combination with cultivator disks, and which can be expeditiously applied to the forward or rear axles of an ordinary farm wagon, or to a similar vehicle, and provide means for lowering and raising the cutter and cultivator disks.

BEET PLOW.—L. BRENNEIS, Oxnard, Cal. An object of this inventor is to provide a plow with bell crank levers pivoted to the frame, the levers having trendles on one set of terminals with a yoke pivoted to the frame, the yoke having a pin which engages the draft bar to shift it.

Of General Interest.

ANIMAL-TRAP.—G. J. MILLER, Marco, Mont. When the jaws are sprung, and the animal is caught beneath either one, if not instantly killed or disabled, he naturally seeks to escape by crawling out under the jaw. To prevent escape in this manner, each end of the body of the trap is provided with a fang which will ordinarily pierce the skin or body of the animal when the trap is sprung, which prevents his movement in any direction.

DISAPPEARING TABLE.—G. H. WITTHAUS, New York, N. Y. This table is adapted for use in launches, yachts, apartments, automobiles, and railway cars. One object of the invention is to provide means whereby a removable section of a floor may be utilized as a table, reclining couch, bench, or a settee. Articulated members support the floor section which may be received within a pit below the surface of the floor.

Machines and Mechanical Devices.

FLYING MACHINE.—P. V. WADLEIGH, Needles, Cal. The invention relates especially to machines of the aeroplane type. The machine is provided with mechanism for raising the same to the desired elevation and having independently operated propellers for advancing the machine. The invention resides in the construction of the lifting and propelling mechanism and in the guiding mechanism.

WELTING MACHINE.—J. LARSEN, Vestergade 11, Copenhagen, Denmark. The invention relates to means for handling welts in welting machines and in other forms of machines for sewing leather, the more particular object being to provide means whereby the welt is fed step by step into a position favorable for enabling it to be pierced by the needle.

VALVE.—A. PALL, New York, N. Y. The more particular object of this inventor is to produce an efficient type of valve suitable for use in connection with liquids or gases and especially adapted for handling illuminating gas. The invention comprises details of construction whereby the closure of the valve is rendered positive and the general efficiency of the valve is greatly increased.

WIRE-FRAME MACHINE.—A. PIASSA and H. COHN, New York, N. Y. One object of the invention is to provide a machine which is capable of a plurality of adjustments to permit frames of widely different forms to be fashioned thereon, and which can be operated to release a frame after the latter is formed without destroying or altering the form of the frame.

SPEED-CONTROLLING DEVICE.—C. E. PALMER, Spokane, Wash. The device requires very little attention and is connected to a revolving part of the device to be controlled, with a view to cause the device to run at all times at a sure, steady, even speed, although the power or the load may increase or diminish instantly or gradually.

FLYING MACHINE.—M. B. SELLERS, Baltimore, Md. The weight of this machine is supported by the air impinging on one or more surfaces, inclined at a small angle of incidence and in motion relative to the air, whether this motion is produced by movement of air or by gravity or by propelled mechanism. When by gravity the machine is known as a gliding machine, but it is equally suitable as a power-driven machine.

CONCRETE-MIXER.—W. D. CLOUGH, E. S. CLOUGH, and J. G. CLOUGH, Quincy, Ill. The invention has reference to machinery for working concrete and the like, the more particular purpose being to produce a concrete mixer especially adapted for continuously admixing concrete in successive charges of limited volume. The machine is to a great extent self-cleaning and is not liable to do any pounding.

REGULATOR FOR THE FLOW AND LEVEL OF LIQUIDS.—P. SUTHERLAND, La Luz, New Mex. The invention is particularly useful in devices used in irrigating channels, mining ditches and other water supply conduits. It provides a regulator which is absolutely automatic in operation and which can be adjusted to operate and control the liquid body at different levels and at different rates of flow.

LATHE HEAD.—G. F. FISHER, Torreon, Mexico. More particularly the improvement relates to the means employed for driving the chuck or face plate at any one of a plurality of different speeds. The intention is to provide means whereby the ordinary belt-driven lathe having a cone pulley may be converted into an all gear lathe.

ROAD-MACHINE.—M. M. SICKLER, Pala, Cal. The supporting wheels are operated by gearing, particularly worm gearing, instead of by chains, and the various supporting wheels can be independently operated for steering the machine, and the bed may be raised or lowered, thereby achieving results on a hillside not ordinarily obtainable, since the machine can be practically level upon a decided slope.

COUPON CUTTER AND COUNTER.—F. H. BARTOW, New York, N. Y. This device may be set to accommodate coupons of various sizes, and is adapted to sever or shear rapidly and evenly. The device has a visible dial upon which is registered each coupon as cut, and by means of which all the coupons may be gathered as cut in a removable receptacle.

TYPE-WRITER RIBBON SPOOL.—J. F. O'CONNOR, New York, N. Y. This improved typewriter ribbon spool is provided with a cast hub to which the flanges are riveted, thus permitting quick, convenient and accurate assembling of the parts without the aid of skilled labor and thereby reducing the cost of manufacturing to a minimum.

Pertaining to Vehicles.

TIRE ARMOR.—W. J. BELYEA, Port Huron, Mich. The invention relates particularly to improvements in a guard armor or protector for rubber tires of automobiles, although it may be used on rubber tires of other vehicles, the object being to provide an armor that may be readily placed over a tire and absolutely protect the same from wear or abrasion, and also enable the use of a brake directly to the tread of the wheel.

LOCK FOR CYCLES.—J. M. BARRETT, Fostoria, Ohio. The invention comprehends a lock mounted upon the framework of a bicycle and provided with a movable bolt adapted to project through the sprocket wheel, the bolt being so arranged that when in its normal position the bicycle cannot be used, the bolt being withdrawn from the sprocket wheel by aid of a key carried by the operator.

TRANSMISSION APPARATUS.—J. O. FORKER, New York, N. Y. The object of this inventor is to provide a mechanism whereby the rear or driving wheels of a motor vehicle can be placed thereon without in any way altering the motor vehicle, and the power from the driving of such wheels will be applied to a power transmission member such as a belt pulley.

LUGGAGE-CARRIER.—L. E. DRAPER, Santa Cruz, Cal. One of the objects in this invention is to provide an adjustable luggage carrier adapted to be mounted on a vehicle, for carrying trunks, bags, or other receptacles, secure against accidental displacement or loss, the carrier when not in use being adapted to be folded together.

ARMORED TIRE.—S. T. MORRIS, Huntdale, N. C. The improvement is in that class of tires which are armored and in which an air tube of the usual design is contained within the outer tube. The aim is to provide a tire and means for protecting the air tube from puncture and also to provide means for preventing "skidding" or slipping of the wheel and further to increase the traction and prolong the life of the tire.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

TO AND FRO THE KEY TO LONDON. London: Simpkin, Marshall, Hamilton, Kent & Co., 1909. 12mo.; pp. 243. Price, 6d.

Few people are aware of the many and valuable facilities of communication which await them in London, practically at their very doors, in the shape of the general public conveyances, and fewer still know how to completely avail themselves of these facilities so as to reach any part of the British metropolis with the greatest dispatch and comfort. The present volume is published with the object of enabling them to make full use of these advantages. Great strides have been made in the past year in effecting rapid transit in London, and the guide before us enables the best advantage to be taken of the opportunities afforded. The work of compiling a book of this nature is colossal, and the publishers can be congratulated on the production of a unique book.

LIFE IN THE NAVY. By Thomas Beyer. Chicago: Laird & Lee, 1909. 16mo., 246 pp. Price, 25 cents.

This book is published by special authority of the United States Navy Department, and is indorsed by ex-President Roosevelt, Admiral Dewey, and Rear-Admiral Evans. It contains a vast fund of useful information which will prove of value to all who are in any way interested in the subject.

CATALOGUE OF A LOAN EXHIBITION OF RARE VIEWS OF OLD NEW YORK. New York: Lloyd Title Insurance and Trust Company, 1909. 12mo., 53 pages, illustrated.

We are indebted to Mr. J. H. Jordan, the compiler, for this excellent monograph on the prints which were exhibited a few months ago at 160 Broadway, New York city. The idea of the exhibition was a most novel one and the exhibition attracted wide attention. The quality of the prints was of the very highest, and many of them were practically unique. The present volume is beautifully illustrated, and with a number of half-tone engravings showing the prints *in situ*. The book is beautifully printed on French deckle-edge paper. The present catalogue will be warmly welcomed by all collectors.

HOW TO COOK VEGETABLES. By Olive Green. New York: G. P. Putnam's Sons, 1909. 16mo., 644 pages. Price, $1.

No more unique or welcome aid to a brain-fagged housewife can be imagined than this little series of handbooks in their plaid gingham covers, comprising such a large number of tried recipes. The book is beautifully printed on light-weight paper and it is really a delight to handle it. There are directions for cooking asparagus in 45 different ways, beans 95 ways, cabbage 100 ways, celery 82 ways, chestnuts 19 ways, corn 87 ways, mushrooms 95 ways, although mushrooms are not really vegetable, but fungi. There are 20 ways of cooking the toothsome okra. There are 136 ways to cook potatoes, which is certainly a most remarkable showing. There are 100 ways to cook tomatoes, and 40 different ways to cook turnips. There are besides dozens of formulæ for what might be termed minor vegetables. The other volumes of the series deal with "What to Have for Breakfast," "Every Day Luncheons," "How to Cook Shell Fish," and "How to Cook Fish." The series is worthy of a large sale.

THE EXPLORATION OF EGYPT AND THE OLD TESTAMENT. By J. Garrow Duncan, B.D. New York: Fleming H. Revell Company, 1909. 12mo., 248 pages. Price, $1.50 net.

The present work is a summary of the results obtained by explorations in Egypt up to the present time, with a full account of those bearing on the New Testament. Many years of exploration in Egypt under the direction of Mr. Flinders Petrie have abundantly qualified Dr. Duncan to write on this interesting subject. Many readers will feel grateful to him for explaining the processes of exploration. His general plan of writing is at once popular and accurate. He speaks as an explorer on Joseph's granaries, the route of the Exodus, the treasure city of the Rameses, and unearths many singular facts about them. The illustrations and drawings add a great deal to the vividness of the story, combining to give a book that has long been needed for the average reader.

ITALIAN HIGHWAYS AND BY-WAYS FROM A MOTOR CAR. By Francis Miltoun. Boston: L. C. Page & Co., 1909. 12mo., pp. 380. Price, $3.

A delightful book, sumptuously printed and appropriately bound. The author is in love with his Italy and makes a most entertaining book of it. He has visited many of the out-of-the-way places with which the peninsula is filled. The illustrations are particularly interesting and appropriate.

THE GEOLOGY OF THE CITY OF NEW YORK. By L. P. Gratacap. New York: Henry Holt & Co., 1909. 8vo.; 232 pages. Price, $2.50.

This is the third revised and enlarged edition, and is accompanied with 65 illustrations and 4 maps. There is no one better fitted to treat of this subject than Prof. Gratacap, whose long connection with the American Museum of Natural History has given him [illegible] opportunities for the study of the available material at first hand. The book is excellently made, and is well illustrated by half-tone engravings and diagrams. The facts presented and the statistics have been brought together from many sources and have been classified. The book will certainly [illegible] to develop and complete a correct geological conception of Greater New York. Mr. Gratacap is to be congratulated upon a highly successful scientific book.

GAS ENGINE THEORY AND DESIGN. By A. C. Mehrtens, M.E. New York: John Wiley & Sons, 1909. 12mo.; pp. 256. Price, $2.50.

It has been the aim of the author to prepare a book for all who are interested in gas engines—students, draughtsmen, engineers, as well as the men who operate gas engines of any kind, and wish to become better acquainted with the theory and the why of many things. The book should be of special interest to the technical student, and was, in fact, first prepared for the engineering classes at the Michigan Agricultural College, since no suitable text-book could be found. The reading matter throughout has been arranged carefully and with a definite object in view. The large number of figures illustrating the text have been made as simple as possible. It has also been the aim of the author to make the treatment clear and concise, and for this reason every paragraph should be studied—not merely read over.

AN HISTORICAL REVIEW OF WATERWAYS AND CANAL CONSTRUCTION IN NEW YORK STATE. By Henry Whalen Hill, LL.D. Buffalo: Buffalo Historical Society, 1908. 8vo., 549 pages.

The present volume is a critical study dealing with various phases of the history of New York State waterways. Nothing of the character of the present work has been written before. The book, which is beautifully bound, is filled with papers and documents of all kinds. It is a most voluminous compendium of valuable facts which are particularly interesting at the present time when the subject of internal waterway construction in the Empire State is of paramount importance. The Hon. Mr. Hill is to be congratulated on the completion of so laborious a work.

THE LURE OF THE LAND. By Edith Loring Fullerton. New York: Long Island Railroad Company, 1909. 8vo., 160 pages.

The present attractive work is a history of a market garden and dairy plot which were developed within eight months upon a most unfertile section of Long Island. The section was so bad that it was designated as "scrub oak waste." This work was carried on by the Long Island Railroad Company at Experiment Station No. 1. The author has also written a most valuable book entitled "How To Make A Vegetable Garden." Mr. and Mrs. Fullerton are well known as promoters of agriculture along the latest scientific lines. The book contains a graphic description of the work from the time when the underbrush was cleared and the stumps dynamited until the farm was in its full fruition and they were shipping "home hampers" to the city containing an assortment of fresh vegetables picked before daylight and delivered before dinner. The book is charmingly illustrated and describes the method of procedure which could be utilized in almost any territory. Tables and figures prove that agriculture is far from being either a profitless or dry occupation, with a celery crop at $330 to $1,000 per acre, Brussels sprouts at $500, asparagus at $355, gooseberries at $900, quinces at $1,500, and other attractive crops may be grown at similar profits.

INDEX OF INVENTIONS

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AND EACH BEARING THAT DATE

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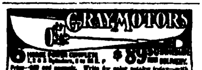

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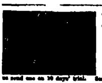

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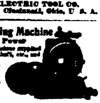

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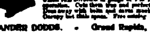

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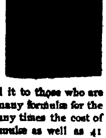

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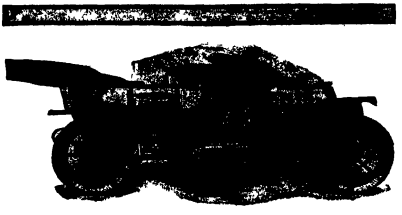

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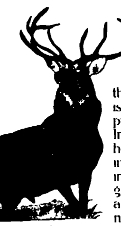
3. Are the men who manage its affairs men of character and high standing in the community upholding the principles of business which assure a long and honorable existence?	3 The Hartford's reputation for commercial honor is its most cherished asset, and its continued observance of good faith with its policy holders is attested by its popularity and success. It is 99 years old and does the largest fire insurance business in the United States.



The service which the Hartford affords the public continues throughout the year and is not limited to payment of losses. It has published a book, "Fire Prevention and Fire Insurance," with separate chapters for Householders, Merchants and Manufacturers, showing each how danger of fire may be reduced in his particular property. The book also gives valuable advice concerning insurance and may save you thousands of dollars no matter in what company you are insured. It is free if you mention the *Scientific American*. Send for it.

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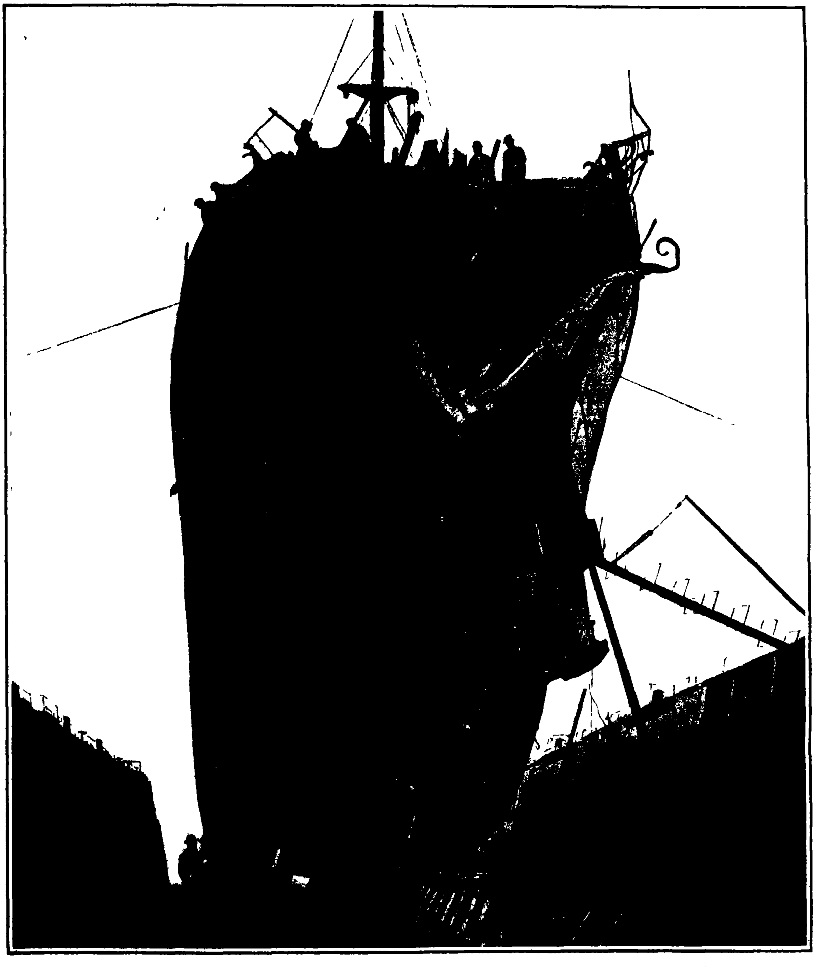

The above illustration shows the "Florida" in the Morse drydock for repairs. The force of the collision flattened thirty feet of the bow concertina fashion into a space of five feet. The wreckage was cut away and a new bow built on in twenty four days.

EFFECT OF COLLISION ON BOW OF ATLANTIC LINER.—[See page 140.]

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NEW YORK, SATURDAY, AUGUST 28th, 1909.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

ANCHORING DOWN THE FLOOR OF THE GATUN LOCKS

The magnitude of the problems confronting the engineers who are building the huge locks at Panama, by far the largest work of the kind yet attempted, is shown by the nature of recent experiments which have been carried on at the site of the lock foundations. The object of these experiments is to determine the best way to anchor down the floor of the locks and prevent it from being lifted bodily by the pressure of the water.

Now, to the average reader the statement that the floor of this huge concrete structure has to be anchored down to the mother rock below will come very much as a surprise, for it has a uniform thickness of thirteen feet. Moreover, since the locks when in operation will be filled with not less than forty-five feet of water, one would imagine that the pressures on the floor would be altogether downward. Yet, as a matter of fact, provision has to be made for maximum upward bending stresses upon the floor, which will occur not when the locks are full, but when they are unwatered for inspection. This upward thrust might become so great that the weight of the thirteen-foot thickness of concrete, plus its own strength to resist bending and breaking stresses, would not suffice to prevent its being thrust up from below and wrecked.

Now, since the floor of a single lock would weigh over one hundred thousand tons, it can be understood that this upward pressure, tending to burst in the floor when the lock is empty, must be of enormous proportions. The question will naturally be asked, What is the character of a force which is capable of lifting up and breaking apart a mass of concrete one thousand feet long, one hundred and ten feet wide, and weighing one hundred and four thousand tons?

The answer is that water seeping through the surrounding ground, and possibly following along the sides of the lock from the Gatun Lake and collecting below the floor of the lock, might expose the latter, when the lock was emptied, to a hydraulic pressure equivalent to that exerted by a column of water eighty-seven feet in height, that being the vertical distance or head from the under side of the floor of the lock to the level of the water of the Gatun Lake. Those of our readers who are familiar with the principles of hydraulics will understand that should such a seepage occur, and a film of water gather beneath the lock when it was empty, and should there be a clear connection between this film of water and the body of water in the lake, a hydrostatic pressure acting vertically against the under side of the floor of the lock would be established.

The engineers have guarded against such seepage of water by sinking a deep curtain wall through the ground beneath the entrance to the locks, extending this wall down the full length of the locks against the outside wall and sinking it everywhere to the impervious underlying rock. The possibility of seepage past this wall is very remote, but such is the extraordinary care which has been taken to render the Panama Canal absolutely secure against disaster, that it has been decided to consider the floor of the locks as liable to this seepage and this upward pressure, and take special steps for anchoring the floor down to the rock below. Experiments have been made to determine the effect of anchoring steel bars in the rock underlying the floor, for the purpose of ascertaining to what extent they could be trusted to hold the floor down against upward pressure. A number of old French steel rails were sunk in the rock to depths of from five to fifteen feet, and secured therein by concrete. In the test on a rail put down five feet, the rock began to crack under a pull of [illegible] pounds, and finally gave way under a pull of [illegible] pounds. The second rail anchored ten feet deep resisted all efforts to pull it up, the apparatus breaking under a pull of 237,750 pounds.

The Board of Engineers having the investigation in hand found that the maximum thrust to be resisted above the intermediate gate sill is that due to eighty-seven feet of water. This thrust would occur in case the lock and forebay should be pumped dry for examination and a full head should develop under the entire area of the floor. It has been decided that this can be resisted by a floor thirteen feet in thickness, anchored down to the rock below by rails spaced six feet apart over the whole floor of the lock, each rail having a resistance of 128,000 pounds. The depth of the anchoring rails in the rock will be increased to fifteen feet in the middle part of the lock floor.

FAR-SIGHTED POLICY OF IMPROVEMENT.

When the early railroads of the United States were projected, the scarcity of capital made it necessary to build them on the cheapest possible plan. In locating the new lines care was taken to interfere with the natural configuration of the ground as little as possible. Deep cuts were avoided. When the engineer encountered a bluff he located his line around instead of through the obstruction, and if his survey was being made along the flanking hills of a tortuous valley, he made the line conform closely to the configuration of the ground, using many and sharp curves in the effort to avoid costly work of excavation with pick, shovel, and dynamite.

Sharp curvature and steep grades, however, though they may secure for the railroad company a line that represents but little first cost, involve a very heavy cost of operation. The resistance of sharp curves and grades of two per cent and over limits the number of cars that the individual locomotive can pull. To move a given tonnage of freight or number of passengers over a crooked and hilly road may call for two or even three times the number of locomotives and train hands that are necessary to haul the same traffic over a road that is fairly straight and reasonably level.

As the years went by it began to be evident to the railroad companies that it would pay to spend a considerable sum of money in straightening out curves and reducing grades, since the interest on the capital thus invested would be more than offset by the reduced expenses of operating the improved road. Consequently, the railroads, as soon as their finances would permit, began to eliminate the worst features of these hastily and cheaply constructed pioneer roads. The work of revision has been carried on more or less steadily throughout the seventy-five years that our railroad system has been in existence, and during the past two decades the sums of money that have been spent in relocating and rebuilding the lines have been enormous. The Union Pacific Railroad expended a few years ago between thirty and forty millions of dollars in cutting down grades and straightening the line on its Rocky Mountain division, and more recently the Pennsylvania Railroad has laid out an even greater sum on its crossing over the Alleghany Mountains.

The latest and in some respects the most striking enterprise of this character is a cut-off which is being made by the Delaware, Lackawanna & Western Railroad, by which it will shorten a forty-mile stretch of its line between New York and Buffalo by eleven miles, reducing the grades from sixty feet to the mile to a maximum of less than thirty feet, and reducing the total length of the curves from thirteen miles to less than five miles. Yet although the total length of the cut-off will be only twenty-eight and one-half miles, its construction will cost $13,000,000, which is equal to an average of about $450,000 per mile.

The principal object of this cut-off is to enable the railroad to haul its heavy coal traffic by a short and easy route across the divide between the Delaware and the Passaic and Raritan rivers. The present line runs to the south of a direct line, making a detour of forty miles, in which, as mentioned above, the grades reach sixty feet to the mile and there are over thirteen miles of curvature. The new line extends from Lake Hopatcong north to Andover and to the Delaware River in an approximately straight line. In order to eliminate curvature and grades it became necessary to make some of the deepest cuts and the loftiest and longest embankments in existence. One cut through the solid granite is over one hundred and fifty feet deep at the point of greatest maximum depth and is over a half a mile in length. Out of this cut alone must be blasted over half a million cubic yards of rock. Beyond the cut is being built the greatest railroad fill in this country, if not in the world. It will be over three miles in length, and from seventy-five to one hundred and ten feet in height. Into the embankment when it is completed, there will have entered over six and one-half million cubic yards of material, [illegible] half times as much material as was [illegible] two huge excavations in New York [illegible] Pennsylvania and New York Terminal stations.

THE WRIGHT AEROPLANE INFRINGEMENT SUIT.

A suit in equity has been brought by Orville and Wilbur Wright against the Aeronautic Society of New York to prevent further exhibition and use of the Curtiss aeroplane owned by the Society, on the ground that the machine is an infringement of the Wright patents. If the suit is brought to a final hearing, it will result in the first complete review of the state of aeroplane art in patent law, and will settle once and for all who should be legally acknowledged as the inventor of the balancing devices which are now employed in many aeroplanes.

Although we have not complete data before us, it is safe to say that the Wrights will undoubtedly base their chief claims for infringement on their method of warping the planes. Whether or not this method is new with them must, of course, be determined by a court. To understand just what warping the wings means we must first understand something of the principles of an aeroplane's flight. An aeroplane may be defined as a surface propelled horizontally in such a manner that the resulting pressure of air from beneath prevents its falling. Such a plane runs on the air like a skater over thin ice, to employ a simile invented by the late Prof. Samuel P. Langley. The most familiar example of an aeroplane is the kite of our boyhood. We all remember how we kept it elevated even in a light breeze by running with it against the wind. The cord may be regarded as the resultant of two forces acting at right angles—the one the pressure of the wind, the other the weight of the kite. Substitute the pull or the thrust of a propeller for the horizontal component (pressure) and an areoplane flying machine is created. If this were all, the problem of artificial flight would have been solved long ago. There remains the extremely difficult art of balancing the plane so that it will skate on an even keel. Even birds find it hard to maintain this stability. In the constant effort to steady himself, a hawk sways from side to side as he soars, like an acrobat on a tight rope. Occasionally a bird will catch the wind on the top of a wing, with the result that he will capsize and fall some distance before he recovers himself. If the living aeroplanes of nature find the feat of balancing so difficult, it is no wonder that men have been killed in endeavoring to discover their secret.

A sailing canoe in a stiff breeze affords a striking example of what this task of balancing an aeroplane really means. As the pressure of the wind on the sail heels the canoe over, the canoeist must climb out on the outrigger, so that his weight will counterbalance the wind pressure and so that the moment of gravity will counterbalance the moment of air pressure. In a canoe the feat is comparatively easy; in an aeroplane it may demand constant and flashlike shifting of the body, because of the incessant variations of the wind. Otto Lilienthal, a pioneer experimenter with the aeroplane, met a tragic death after he had succeeded in making over two thousand short flights in a gliding machine of his own invention, simply because he was not quick enough in so throwing his weight that the centers of air pressure and gravity coincided. Pilcher, an Englishman, came to a similar violent end for a similar reason. Octave Chanute in the United States continued the work of the ill-fated Lilienthal. Realizing the inherent danger of a glider in which the operator must adapt himself to the changing center of air pressure with acrobatic agility, Octave Chanute devised an apparatus in which the center of air pressure was mechanically controlled, so that there was no longer the perilous necessity of indulging in aerial gymnastics. In his machine the tips of the planes, when struck by a gust of wind, would fold slightly backward, thus considerably curtailing the tendency of the center of air pressure to shift. The Wright brothers warp the ends of the planes for the same purpose. In his earlier machines Curtiss, instead of warping the ends of the planes, employed wing tips which were moved up or down. The effect was the same. In the new Curtiss machine acquired by the Aeronautic Society and involved in the present infringement suit no attempt whatever is made either to provide the main planes with movable tips or to warp them. Instead, the balancing planes are carried between the main supporting planes. These intermediate balancing planes are rotated about horizontal axes in order to balance the entire machine. The court will therefore be called upon to [illegible] whether or not these intermediate planes, [illegible] entirely unconnected with the main supporting [illegible] are the mechanical equivalents of the Wright brothers' plane-warping devices. If they are, the court [illegible] further have to pass upon the [illegible] nute's wing tips were an [illegible] brothers' plane-warping invention [illegible]

ENGINEERING.

The Next National Conservation Congress of the United States will be held on August 26th, 27th, and 28th at the Alaska-Yukon-Pacific Exposition. Invitations have been sent to ten thousand prominent men in the States where conservation is receiving official attention. The Seattle congress will perfect a permanent organization, and will select representatives to attend the World's Conservation Congress at The Hague.

The squadron which Germany will send to the Hudson-Fulton Celebration will consist of Germany's latest armored cruiser, the 11,600-ton 22.5-knot "Gneisenau", the protected cruisers "Hertha" and "Victoria Louise" of 5,660 tons and 19 knots speed, the "Bremen" 3,250 tons and 23.3 knots, and the "Dresden," one of the new 3,600-ton fast scouts of which Germany is building so many, of 24.5 knots speed.

With the old Metropolitan line, 71 miles in length, and the Metropolitan District line, 28 miles in length, included, the network of London's subways and tubes has a total length of over 145 miles. London was the first city to inaugurate subway travel The Metropolitan line, which for many decades was operated by steam, was put in operation over half a century ago

In his testimony before the House Committee, Rear Admiral Mason recently estimated the life of an 8-inch gun at 200 rounds. As first constructed, the 12 inch gun began to deteriorate by erosion at 80 rounds, but by reducing the velocity and using a broader copper rifling band, its life has been extended to about 150 rounds. After 150 rounds it would be necessary to reline the gun at a cost of $12,000, which is about one-fourth the first cost of the gun

As one outcome of the experiments and conferences that have been held during the past three years between railway men and rail makers it was determined to seek the co-operation of the Bureau of Standards of the Department of Commerce and Labor Director Stratton has entered into hearty co-operation, and experiments looking to the improvement of steel rails will henceforth be made under the joint auspices of the maintenance of way engineers the managers of the rail mills, and the experts of the Bureau of Standards.

The navy collier "Nero," which went ashore on Brenton's Reef on July 2nd during a dense fog, was successfully floated by the Arbuckle compressed-air method. The deck was made airtight, and by means of powerful compressors the water was gradually expelled from the hull through the rents in the bottom When the ship had been sufficiently lightened, she was pulled from the rocks by the united efforts of tugs and salvage vessels.

There is now nearing completion a six foot steel main, which is being built to supplement the masonry conduit which carries the Brooklyn water supply from Nassau County It is twenty-three miles in length and will cost over $2,500 000 The present masonry conduit has a daily capacity of 120 000,000 gallons. The daily consumption of Brooklyn and Queens is 142,000,000 gallons, part of which is drawn from local artesian wells. The new steel main will have a capacity daily of 55,000,000 gallons.

That the illumination of New York city in connection with the Hudson-Fulton Celebration has been planned on a worthy scale is shown by the announcement that it will include 1,500,000 additional incandescent lights, 10,000 arc lights, and two batteries of searchlights, the total capacity of which independently of the city lights and private illumination will be 26 260,000 candle-power A dramatic feature will be the lighting of twenty immense signal fires upon mountain peaks along the Hudson from New York city to Newburg.

Everyone who admires the stately trees of the old New England towns—and who does not?—will be gratified to know that tree planting is being carried on systematically on the Massachusetts roads. The report of Mr E. W Breed, forester of the State Highway Commission, shows that during the year ending November 30th, 1908, 1,184 new trees were planted and 744 old trees were replaced. During the preceding five years, 12,112 trees had been distributed among fifty-five towns. The cost in 1908 of new trees averaged $1.29 each, and the average cost of maintenance was [illegible] cents per tree.

By the courtesy of the commandant of the Naval Training Station, the committee which have in charge the Portola Festival, commemorating the discovery of San Francisco Bay by Portola in 1769, have constructed on Yerba Buena Island, San Francisco Bay, what is probably the largest sign ever erected. The sign, which has been put on the sloping hills of the island, is [illegible] feet long by 125 feet high. The words "Portola Festival, October 19th-23rd," are arranged in two lines, each letter of which occupies a space 48 feet by [illegible], the stroke of the letters being 5 feet in width. [illegible] 2 inches in [illegible] shows up [illegible]

ELECTRICITY

The eight-track swing bridges across the main channel of the Chicago drainage canal near 31st Street will be operated by electricity

An interesting article in the August number of the Fine Arts Journal describes the artistic possibilities of electricity both for decorative lighting and more utilitarian purposes of facile hospitality from electric toast racks to chafing dishes.

The electric railway up Mont Blanc is now open to the public as far as the Col de Voza, 5 495 feet high The first train took nearly an hour to accomplish the journey of 4¼ miles. There are no tunnels and the steepest grade is 20 per cent, some magnificent views of Alpine scenery being obtainable from the cars.

The Boston & Maine Railroad has bought the hydro-electric power plant at Eastman Falls on the Pemigewassett River, and concessions for undeveloped water power in the same neighborhood The company has large shops in the vicinity, and also operates trolley lines, for which this power will be available

With very little ostentation, the Commercial Cable Company has recently completed what will probably be a very valuable improvement, landing at Manhattan Beach the shore end of a new cable from St John's Newfoundland The new line is 1 300 miles long and is spliced to the transatlantic line 270 miles east of St. John's. It is expected to greatly accelerate transmission of messages from New York and southern points to Europe.

Few people would imagine that an electrical instrument factory requires a staff of expert jewelers, but the cutting in special forms, polishing setting and mounting of diamonds, sapphires, and rubies forms an important part of the work of the General Electric Company's meter factory at Lynn, Mass. Details of the operations involved are described in an interesting article by J G Baker in the current Electrical Review

The increasing use of electrical energy upon a large scale in industrial establishments renders necessary the adoption of numerous precautionary measures and it is to the credit of the great industrial corporations of this country that they not only recognize this fact, but employ special officials to give effect to the safety regulations adopted An admirable article on this subject by Mr R J Young safety inspector of the Illinois Steel Company appears in the Electrical World of August 12th

A fire alarm was recently sent to a station ten blocks from the scene of the fire by a route over 200 miles long. A car of coal caught fire at Edwardsville Ill the station of which has no telephone The station agent called Decatur, 100 miles away by telegraph where the dispatcher called Poag the nearest station to Edwardsville having a long-distance telephone The Poag operator rang up the Edwardsville exchange where the telephone operator rang the alarm in the fire station, and the engine was on its way only three minutes after the station agent reported the fire

Rio de Janeiro is one of the first capital cities of the world to be adequately supplied with hydro-generated electric power The current is transmitted at 88,000 volts from the generating station at a water power 51 miles away to a receiving station in the city, where it is stepped down by transformers to 6 300 volts, at which pressure it is supplied to the general feeders for lighting and power The general distribution is by means of four wire three-phase system giving 120 volts to lamps, etc between outside wires and neutral—the first time that this system has been tried upon so large a scale.

A patent was granted to Mr J H Cuntz on July 13th for a method of making wireless signals selectively audible by means of acoustic attachments A tuning fork is magnetically associated with a mechanical interrupter in the sending circuits, by means of which the high-frequency wireless telegraph current is interrupted throughout each signal at a rate corresponding to the pitch of the tuning fork An identical tuning fork magnetically associated with the receiving circuit gives forth an audible sound when the wireless signals are interrupted at a rate corresponding to its pitch, signals being heard only when the forks at both stations have equal pitches.

The great silver-mining district of Cobalt has been turning its attention to generation of power by water on account of the high cost of power due to the distance which fuel has to be conveyed The average cost of power hitherto has been $175 per horse-power year, some mines even paying as much as $400 A grant of land has been made at the head of Lake Temiskaming on the Matabichewan River, about 25 miles from Cobalt, where there is a large water power available, and a big hydro-electric power plant is being erected. The current will be conveyed to the mines, and either electricity for other power purposes or compressed air from electrically-driven compressors will be sold to consumers.

SCIENCE.

The municipal council of St Petersburg has decided to name the newly installed municipal laboratory after the celebrated Russian biologist Metchnikoff, who is at present connected with the Pasteur Institute of Paris. It will moreover found an annual prize of 1 000 rubles this to be known as the Metchnikoff Prize and it is to be awarded for the best work in biology

In a recent lecture before the Society of Arts Eyde gave some details concerning the present condition of the manufacture of artificial nitrates at Notodden, where large quantities of calcium nitrates are produced and sold in competition with nitrates from Chile. The annual production of nitrate of soda in Chile is 1 800 000 tons In 1920 this may be expected to be increased to at least 2 500 000 tons At the same epoch the Norwegian production will amount to about 300 000 tons or only 12 per cent of the Chilean Meanwhile of course other factories may be established which will largely increase the total production of artificial nitrates Nevertheless Eyde does not fear competition in view of the constant increase in demand throughout the world From experiments made in various countries it may be concluded that artificial nitrate is as good a fertilizer as Chile saltpeter and on some lands a better one

The age of a fish can be determined with accuracy by inspection of the otoliths or bony concretions which are found in the auditory apparatus These otoliths increase in size during the entire life of the fish each year adding two layers a light-colored one formed in summer and a dark one formed in autumn and winter The alternate layers are sharply contrasted and very distinct so that there is no difficulty in counting them The number of pairs of layers is equal to the number of years the fish has lived By this method Wallace has made an interesting study of the distribution of fishes of the plaice species over various sea bottoms according to age In this way the rapidity of growth of fishes and the effect of fisheries on the population of the sea can be determined

The new German exchange professor for Columbia University is Dr Karl Runge of Gottingen Germany Prof Runge was born at Bremen in 1856 studied at Munich and Berlin receiving the degree of doctor of philosophy at the latter institution in 1880 Before his appointment at Gottingen he was professor in the Technical High School at Hanover He has an excellent command of English Dr Runge's first original work was in pure mathematics and he early obtained a high position among German mathematicians Of later years his interest has been more largely in applied mathematics He has, for instance made important investigations in spectrum analysis and in astronomical and nautical researches His most recent specialty and one upon which he will give a course at Columbia is the study of graphical methods in physical and technological research

By using the soundings shown on the Admiralty charts Prof Edward Hull has demonstrated that a series of isobathic contours can be drawn showing the form of the ocean bed In this way we can determine the margin of the continental shelf which breaks off into deep water near the 100 fathom contour, as also the channels of the submerged river valleys which traverse it down to depths of about 1 000 fathoms By this means those of the English Channel River and those of the Loire the Gironde and the Adour off the coast of France also those of the Caneira Arosa, Lima, Douro Mondego and Tagus from off the coast of Spain and Portugal have been determined The existence of these channels, formed by erosion under land conditions indicates great changes of level in late Tertiary times resulting in the climate of the 'Glacial period "

The existence of a rich fauna in the sea proves that the salts contained in potash wastes if sufficiently diluted are not injurious to fish Nevertheless it has frequently been observed that if strong saline solutions are discharged into streams, the salt is distributed throughout the water very slowly In some cases a strong saline current, sharply distinguished from the rest of the stream, persists for several miles, and may destroy either the fish or the organisms upon which they feed Chemical purification of the waste waters of the potash manufacture has been attempted In the Mehner methods the waste water which contains a large percentage of magnesium chloride is mixed with lime which precipitates the magnesia in the form known as Sorel cement This mass, mixed before setting with inert substances may be used for filling the voids caused by the extraction of the potash salts, or solutions of magnesium chloride may be concentrated to a strength of four molecules of water in which condition the salt takes up two additional molecules of water and may therefore, be used in dehydrating additional quantities of solution thus producing a pasty mass which is convenient for the filling of voids.

REPAIRING THE CRUSHED-IN BOW OF THE "FLORIDA

The extraordinary photograph reproduced on the front page of the present issue shows the result of one of the most tremendous collisions in the history of ocean navigation That concertina like mass of crumpled up steel plating and framing represents the effect of the blow struck by a steamer weighing seven thousand tons and moving through the water probably at not less than twelve knots an hour when it crashed squarely into the side of an even huger vessel weighing about twenty five thousand tons and itself moving at a speed somewhat less The energy of the blow struck by the Florida was not expended until thirty feet of her bow had been crushed and jammed tightly together into a space of five feet But with this dramatic picture before us telling its own unmistakable story it is needless to multiply words by way of description

The "Florida" with her new bow completed, 24 days after repairs were commenced

It was during thick weather on January 23rd 1909 that the steamship Republic of the White Star Line was feeling her way past Nantucket lightship when suddenly out of the fog loomed up the bow of the Florida so closely aboard that nothing could be done to avert the collision The blow was delivered squarely amidships The Florida's bow crushed through the side plating of the Republic and entered the engine room tearing open a gaping vertical hole which extended from the main deck down to the bilge The subsequent history of the disaster including the call for help by wireless and the speedy rescue of the passengers of the Republic needs no repetition here The gradual giving way of the bulkheads of the stricken ship sealed her fate and she now lies in some four hundred feet of water Thanks to the staunchness of the construction of her collision bulkhead the Florida although thirty feet of her bow had been smashed in was able to make her way to New York under her own steam

To those who went down to the Bush docks in South Brooklyn to take a look at the Florida it seemed as though the terrific impact of the collision must have strained the ship so severely as to necessitate many months of careful overhauling and repair Several weeks elapsed indeed before the owners made any call for tenders for the work of repair which involved the construction of an entirely new bow on the vessel The contract was let to the Morse Dry Dock and Repair Company who agreed to cut away the old wreckage and build a completely new bow in the extraordinarily short time of twenty four running days and for the sum of $39 [illegible]00 The nearest competitor asked for thirty four days while one contractor considered that to complete a job of this magnitude would require fifty six days or two and one third as much time as that in which the job was actually done

It has been a matter of common belief on the part of the public that American shipyards are unable to turn out work at the speed which obtains in foreign yards There was a day when this may have been true but with the increased experience the better tools and the splendid plants which have been built of late years around our seaboard and on the Great Lakes the art of shipbuilding has made prodigious strides It is safe to say that work can be turned out of as high quality and in as short a time in the best of our yards to-day as it can in those of the European shipbuilders, and of this fact the remarkable job done on the 'Florida" affords strong evidence

View looking forward, showing after side of the chain-locker bulkhead. This section, representing 30 feet of the bow and weighing [illegible], was crushed into a mass 5 feet in thickness.

Wrecked bow lifted away from the ship by floating derrick

REPAIRING THE CRUSHED-IN BOW OF THE "FLORIDA."

Immediately upon the awarding of the contract, workmen armed with pneumatic tools cut through the plating and the decks from the rail down to the waterline the general line of cutting being about two feet aft of the farthest point of damage Telephone and telegraph were meanwhile busily at work and while the wreck of the bow was being cut off the mills were furnishing the new steel frames and plating and a new steel stem piece was being cast by the New Jersey Steel Company in New Jersey The contract time for the latter was six days; but the patterns for the whole piece and the steel casting itself were made, and the latter delivered at the Morse yard, in three and a half days time In five days after beginning repairs the "Florida" was placed in drydock, stern first, and at one o'clock the workmen were cutting through the remaining portion of the hull from the waterline down to the keel The 300-ton floating derrick 'Monarch" was now brought to the open end of the floating dock Chains were shackled onto the broken bow; and at a quarter past six the same evening the shapeless mass weighing about one hundred tons, was lifted from the ship It was subsequently sold as junk for seventy-five dollars.

The next step was to lower the floating dock, float the ship out, turn her around, and float her back into the dock, so that the bow would be near the workshops and convenient for the transport of material The new stem was immediately placed in position, the new frames erected the riveting of the plating begun and so quickly did the work proceed that thirteen days after the lifting off of the old bow the ship was floated out of the dock with the plating in place riveted, and painted to some distance above the waterline Less than two weeks later the job as specified by the contract was completed with the decks, rooms and all fittings in position It was done within the contract time of twenty four days with a margin of a few hours to spare

Before closing reference should be made to the curious fact as shown by the photograph that the forecastle deck was not crushed together like the body of the bow below Evidently at the time of collision the top deck of the Florida stood a few feet higher above the water than the top of the side plating of the "Republic", and, as the ship crushed into the "Republic" her forecastle deck must have reached out intact above the main deck of the Republic' When the two ships tore apart the thirty feet of projecting deck of the 'Florida broke and bent over with its own weight and hung down in the position shown in the engraving Our thanks are due to Mr E P Morse general manager of the Dry Dock Company for photographs and data used in the preparation of the present article

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In the early part of the present year the French Academy of Sciences discussed a communication in which it was asserted that the human body emits radiations which affect photographic plates In the course of the discussion De Fontenay demonstrated that the effects which had been attributed to radiations could be explained perfectly by the warmth and moisture of the body Later an attempt was made to sustain the theory of human radiations by the statement that the Lumière company had been compelled to discharge several employees who fogged the plates that passed through their hands. De Fontenay investigated the matter and found that nothing of the kind had ever occurred at the Lumière factory. Each case of fog was due to accident and to well-known causes—finger-marks, packing strips, pattern fog etc.—not to mysterious human radiation. In regard to [illegible] magnetism and other occult agencies, it is [illegible] enough to be [illegible] with crude experiments [illegible] [illegible]

THE EDISON CONCRETE HOUSE.

Although Mr. Edison has left his mark upon more [illegible] developments of the world's progress than perhaps any other living scientist, and is now past the age at which the majority are most productive, he is now giving most of his time to an invention which he himself considers the greatest thing he has ever done.

The name of Edison is associated in the popular mind principally with electricity, the wide range of the inventor's improvements in telegraphy, telephony, and lighting being principally concerned with ingenious cajoling of that mysterious fluid, but his present work is as far removed from delicate electrical devices as monolithic masonry Even more widely known than his electrical devices are Mr Edison's inventions of which the principal use is the amusement of the people, the phonograph and the kinetoscope, the former of which, considered by itself apart from its commercial or industrial value, remains perhaps the most wonderful machine of all, but Mr Edison now goes on from the amusement and recreation of the masses to the amelioration of their material surroundings, and thereby to increasing their self respect. This, as Mr Edison says is surely worth doing, and in its intended effect in the betterment of mankind is truly more a philanthropic than a commercial undertaking.

Specimen mural decoration cast in concrete.

Mold from which it is cast.

The ultimate object of the present invention is no less than the provision of a means whereby individual workingmen's homes—artistic, comfortable, sanitary, and not monotonously uniform—may be turned out in such quantity and so cheaply that their rent, including car fare to and from the tenant's work, will not exceed, say nine dollars a month. Mr Edison hopes thereby to depopulate the swarming tenements of congested cities, and provide their occupants with surroundings morally, mentally, and physically more healthful

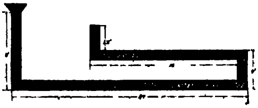
Reinforced concrete is the material adopted, and by Mr Edison's method, after the erection of suitable molds, an entire house, including walls, floors roof, molding, cornices, bath and laundry tubs, is "poured" at one operation, much as one might squeeze paint out of a compressible tube and leave it to set.

Rumors of this intention have been in the air for some time, and have been received with more or less incredulity or derision by the technical press, but experiments upon a practical scale have now reached a stage of progress at which Mr Edison is confident of ultimate success, and permits the present authentic description

Mr Edison's first intention was to build a two-family house, and considerable work was done in preparation of the molds, but the designs submitted by architects he had employed did not prove adaptable to the system, and it was found that there was a growing demand for single houses. Mr Edison therefore set his own engineers, Messrs. H J Harms and G. E. Small, to work exclusively upon the development of the concrete house plans, with the result that under their direction an extraordinarily adaptable set of molds has been produced

The completed "form" for a single house may require as many as five hundred different sectional molds of cast iron bolted together, but the latter are so designed that a dozen houses in a row may be built on the same cellar plan, the first floor molds being disposable in several different ways, and the second floor molds likewise, so that no two houses of the dozen need be alike, thus avoiding monotonous uniformity of appearance

The typical house shown in our illustration has a floor plan 25 x 30 feet, intended to be built on lots 40 x 60 The front porch is 8 feet and the back 3 feet wide On the first floor is a living room 14 x 23 x 9½ feet high, and a kitchen 14 x 20 x 9½ at the back From the corner of the living room a staircase leads to the second floor containing two roomy bedrooms and a bathroom 7½ x 7½ x 8 feet. The third floor contains two large low attic rooms but each room has large windows, providing an abundance of light and fresh air A cellar 7½ feet high extends under the whole house, containing boiler, wash tubs coal bins etc.



Result of test of gravity flow of concrete

All the moldings and decorations are cast in the concrete, and not *appliqué* as hitherto in concrete work Our illustration shows a typical piece of decoration with the mold from which it was cast, such decoration molds being of course, changeable with each of a row of houses built

The inside walls require no plaster finish the special mixture used leaving a perfectly smooth surface, which can be tinted as desired Only the doors and window frames and the pipes for water, gas, or electric light wires are of wood or metal making the house not only water-proof and vermin proof, but practically fire-proof, reducing if not eliminating insurance cost.

The foundation and cellar floor should be laid some days before the weight of the molds is put upon them The latter are then assembled complete from cellar to roof, and the special concrete is conveyed from large mixers into a distributing tank at the top of the house whence it flows to every nook and crevice of the molds by gravity until the form is full and the concrete overflows at the top.

The mixture used is much more liquid than usual concrete, in order to obtain free flow, in spite of which there is no segregation of the material or settlement of the heavior aggregate One of our illustrations shows a wooden form or conduit of only 4 inches square section which has been completely filled with concrete poured only a bucketful at a time into the highest end The concrete flowed down 8 feet, horizontally 24 feet up 4 feet horizontally again 16 feet and then up over 2 feet to within a foot of where it entered entirely by gravity and on the board at one side of the form being removed when the concrete had set showed almost perfect uniformity of the material This is a much more extreme test of fluidity than the material would be subjected to in the pouring of a house from the top This result is obtained by the mixture with the concrete of a special colloid, which for the present is Mr Edison s secret

The latter thinks it will be possible to assemble the molds complete in four days to fill the form with concrete in six hours and after allowing six days for setting to remove the molds in another four days. A complete set of molds would therefore be occupied for fourteen days in the building of one house or would be available for about 21 houses in a year, but owing to the interchangeability of parts Mr Edison estimates that with six complete sets of molds 144 houses may be built in a year

The greatest care is taken to make all the mold sections interchangeable a special machine having been designed to plane them uniformly and all bolt holes in their flanges being drilled to templet Such are the finish of the molds and the nature of the colloid concrete that there is absolutely no adherence of the latter to the former The marks of the joints between the molds are rarely traceable on the finished wall and the molds may be used over and over again indefinitely With the present use of wood for forms it is almost impossible to use the latter over again owing to breakage and adhesion and it is cost of the wood that renders the expense of monolithic concrete dwellings prohibitive.

Assembling the cast-iron molds of the "form."
[illegible]

Typical house cast in one piece.

THE EDISON CONCRETE HOUSE

Another great cause served by Mr Edison's system is therefore that of conservation of natural resources, any extensive use of concrete with wood forms causing an actual waste of wood, and materially assisting the much talked-of depletion of forest reserves.

One complete set of molds will cost about $25,000, and the accessory machinery for mixing conveying, etc another $15 000 so that a large capital will be required to build houses in this way but this Mr Edison considers an advantage taking home building out of the hands of irresponsible jerry" builders looking only toward the quick sale or rental of a house.

Mr Edison thinks that the cost of such a house as that described will be about $1,200 including materials, labor interest on plant, complete ready for occupancy with plumbing heating and lighting fittings This prime cost not merely makes low rentals possible but places the ownership of a home, at least upon the instalment plan within the reach of any thrifty workman

The Alteration of the Colors of Flowers by Cultivation.

BY PROF F HILDEBRAND.

In general all the flowers of the same species, in the wild state have the same color For example, all plants of crowfoot or buttercup and dandelion have yellow flowers. In a few species different colors are found For example the flowers of the milkwort (*Polygala vulgaris*) may be blue, violet red or white Much greater variation is shown by cultivated plants. In these the variation of color of the flowers appeared long ago but in recent years many new colors have been produced which had either not hitherto been observed or which if they did appear occasionally, were not selected for preservation and development The floriculturists of the present day carefully observe and endeavor to fix every new shade even if it is not particularly beautiful, for the desideratum is novelty, and there is no telling what will please the popular taste. But in these attempts to obtain new colors in flowers, the propagator is entirely dependent upon the innate predisposition of the particular species with which he is working He can by no means obtain every desired color In the following sketch will be mentioned first a few cases of species in which a color has been obtained which was formerly considered impossible Some other examples will be adduced to show that in certain species a great many new colors and shades but not all colors have been obtained Finally a few other cases will be quoted in which the flowers of a species have shown little or no variation in color during many years of cultivation

A species of primrose (*Primula acaulis*) in the wild state always has lemon yellow flowers which vary only slightly in tint Cultivation has produced both lighter and darker shades but until recently no color but yellow Hence it was the more surprising when a few years ago a pure blue variety was produced, which has since retained its general color but has developed all shades from the palest sky blue to the deep blue of the corn flower The Chinese primrose (*Primula sinensis*) when cultivated in the garden bore until recently only red and white flowers. In this species also other colors have lately been produced, not only violet but also blue though not so pure a blue as that of the species first mentioned Another example is offered by the gladiolus which formerly bore only white and red flowers but has recently developed a blue-flowering variety A case of a somewhat different character is presented by the asters, which have long shown a great variety of colors but in which recently a great many new shades have been produced including some which would not at one time have been considered beautiful, for example copper-color

Very numerous on the other hand are the species which have long shown great variation in color and have recently developed many new shades, with the exception of blue Especially conspicuous in this connection is the dahlia which is now found in every color except blue although many propagators are making earnest efforts to produce a blue dahlia, which would bring great profit to its originator A blue carnation would be equally valuable but it has not yet been produced although the colors of carnations have lately been enriched by many new shades. The new varieties of canna also show great diversity of color including almost pure white and a beautiful light pink but a blue canna has not yet appeared In the begonia not only blue is lacking but also all shades from red to violet Finally, we may mention the variety of poppy called the Shirley which is greatly admired for its play of color Here, however the colors range only from white to rose and vermilion Blue and violet colors are completely wanting and so is yellow which is very common in the begonia.

Other species which have recently produced many new tones, with the exception of blue, include: Pelargonium, Scabiosa, Calceolaria, Antirrhinum Mirabilis Jalapa (Four O'clock or Marvel of Peru), hollyhocks, immortelles, and some species of Phlox and Godetia. The Gilliflowers, Wallflowers, and Balsams belong in the same category, for the varieties of these three flowers which are described as blue in seedsmen's catalogues are not pure blue, but violet.

It should be observed, furthermore, that among species which have produced many new colors, there are some in which the color yellow is wanting. This is the case with some species of larkspur (*Delphinium ajacis* and *D consolida*), with *Dianthus Heddewigii* and with the verbenas and Clarkias.

Finally, there are species which, notwithstanding many years of cultivation, have shown little variation in the color of their flowers or have produced only new shades but not new colors. Among these are the fuchsias, which show only various shades of red A blue or a yellow fuchsia would be a curiosity Another example is furnished by *Cyclamen persicum*, in which many years of cultivation have only changed the original color scheme of a dark red throat and a white or pink tip so far as to deepen the red throat to crimson and almost to violet and, on the other hand, to efface it altogether, producing a pure white flower Quite recently, however, an approximation to a yellow has been obtained by the production of a salmon-pink cyclamen. Similar cases are furnished by the Alpine forget-me-not in which merely the shade of the original blue color has been slightly altered by cultivation, and by the marigold (*Tagetes*), the colors of which vary only from yellow and orange to brown

From the foregoing remarks it is evident that, although very many new colors have recently been produced by cultivation in the flowers of numerous species of plants, the production of these changes is entirely dependent upon the original predisposition to variation possessed by the plant. Without these tendencies to variation, no new color can be produced, either by the gardener or by natural selection, for if there is no variation, selection is impossible —Translated for the SCIENTIFIC AMERICAN from Umschau

Decreased Number of British Patent Applications During the Past Year.

Consul Albert Halstead, of Birmingham, reports as follows concerning applications for patents in the United Kingdom in 1908

According to the report of the Comptroller-General of Patents, patent applications in the United Kingdom in 1908 numbered 28 598, a decrease of 420 from 1907 of the total 572 were from women and 1 459 from abroad the United States furnishing 572 of that total and Germany coming second with 515

The greatest number of applications made in 1908 were in connection with locomotion which, the Comptroller says was due to the continued interest in motor cars and allied subjects A great though smaller activity was shown in connection with wheels, efforts being chiefly directed toward the provision of an easily detachable tire-carrying rim, while many applications dealt with valves for internal-combustion engines Inventions relating to road tarring machines, compositions for treating the surfaces of roads, and dust-collector fittings for motor cars to abate the dust nuisance showed increased interest as did tools for the repair of automobiles on journeys On the contrary, there was some neglect of horse-drawn and railway vehicles.

Many inventors occupied themselves with flying machines of the heavier-than-air type especially in regard to their automatic balancing and facilities for manipulating the various rudders and planes. Again patents in connection with the manufacture of artificial silk showed an increased activity in an industry which the Comptroller reports to be developing It may be said that artificial silk manufactured by a new patent process is one of the new shipments from Birmingham to the United States, and apparently a growing one

The subjects of short-base range finders and eyes, periscopes for submarine boats, automatic railway signals, and systems for giving signals in the locomotive cab, as well as a controlling apparatus for stopping trains which have reached an excessive speed, were in evidence in patent applications. Processes for the regeneration of waste rubber and the synthetic production of rubber or rubber-like products formed an interesting feature of the patents of last year. New methods of using tungsten and other refractory metals for manufacture, by working them in combination with ductile metals which are afterward removed by heating the finished article, also attracted attention, while the stropping of flexible razor blades is an indication of the way in which the idea of a safety razor, since its development in the United States, has been developed abroad

Under a section of the patent and designs act of 1907 providing for the revocation of patents worked exclusively or mainly outside the United Kingdom, several patents have been revoked This section of the British patent law is one that American manufacturers can not neglect without serious danger to their patent rights in the United Kingdom.

Out of the total number of patents sealed—[illegible]— in 1908, the following numbers were sealed to residents in foreign countries: [illegible] many, 2,518; France, [illegible]; [illegible]; Switzerland, 290; Australia, 106; Belgium, [illegible]; [illegible] 155; Sweden, 120; Italy, 134.

Liquid Alloys of Sodium and Potassium.

Jaubert has obtained liquid alloys of sodium and potassium by treating sodium hydrate with metallic potassium, and potassium hydrate with metallic sodium. In both cases liquid alloys are formed, corresponding closely to the compounds NaK and NaK₂. The last-named alloy contains about 80 per cent of potassium.

As 23 parts of metallic sodium, which is comparatively cheap, set free 39 parts of the much more valuable potassium, this reaction may be made the basis of a practical method of producing potassium, in the form of a rich alloy

Air must be excluded during the operation, but if this is conducted under melted commercial paraffine, the temperature cannot be raised above 400 deg. F. and the yield of alloy is diminished by reactions with the impurities of the paraffine. In the laboratory it is preferable to operate in a vacuum, the metal and alkali being placed in a strong retort of Jena glass, which is connected with an air pump and heated by an oil bath. 12 parts of potassium and 4 parts of pure and perfectly dry caustic soda yield the alloy NaK₂. The same alloy is produced when 7 4 parts of sodium are mixed with 16 parts of caustic potash containing 10 per cent of moisture, and the mixture is heated to 437 deg. F, while 5 5 parts of sodium added to 6 parts of potash and heated to 662 deg F yield the alloy NaK. The alloy NaK₂ is made on a larger scale at Clavaux, France, in iron retorts, provided with stirring apparatus. The product contains 77 per cent of potassium.

The Current Supplement.

The practical method of aerial photography has long been sought. Very successful results have been obtained in experiments with kites, which were recently made on French naval vessels by a system designed by Capt. Saconney In the opening article of the current SUPPLEMENT, No. 1756, this system is described The rapid advance of theoretical science in general, and of theoretical electricity in particular, is nearly as bewildering to the physicist and chemist, who is not investigating electrons and ions, as it is to the engineer The old notions, we are told, are not wrong, but they must be modified in the light of recent research A general exposition of the problem of the conduction of electricity will therefore be welcomed Such an exposition (a cautious guide and not an immature theory) is given by Prof. J Koenigsberger Mr E. F Lake s admirable discussion on the Oxhydric Process of Cutting Metals is concluded. Interesting in the light of the recent introduction of tantalum and tungsten for lamps is Dr C Richard Boehm s article "The Forerunners of the Metallic Filament Incandescent Lamp" Maria Parloa's treatise on Canning and Preserving Fruit is concluded. Recent discoveries have filled up to a great extent the gaps in our knowledge of Palæolithic man. A general review of the present status of the subject is given by A C Haddon Atmospheric circulation is discussed by R. F Stupart. The first of a series of articles on Imitation Arms and Armor and how they are made is presented. Arthur Watson writes entertainingly on Conjurers of the Past, and delves up many a bit of historical magical lore. Experiments have lately been made by M. Blum with a simple apparatus designed to demonstrate the rotation of the earth on the plane of oscillation and support of a simple pendulum. The experiments are summarized by J J Davis and H. F. Purday

Ancient Records of Halley's Comet.

Andrew C. D. Crommelin in an article on "The Expected Return of Halley's Comet" in Science Progress (London) gives an interesting account of the early observations of this comet which appears at intervals of about 75 years. The first definite record of this comet is from China where it was observed and fully described in 12 B. C. The various appearances from this time up to that of 1378 were more fully and accurately described in China than in Europe. Its path through the constellations was described in the Chinese records because they "imagined that the terrestrial kingdoms had their counterparts in the sky, and that comets were ambassadors between them indicating corresponding relation between the kingdoms on earth, so that valuable political information was to be gained from this study of the heavens.

In the West the appearance of a comet was [illegible] omen and hence recorded, but its path was not an important feature. Josephus mentions the [illegible] of a comet several months before the fall of [illegible]. This was probably Halley's comet which [illegible] 66 A. D. The death of Emperor [illegible] D. was also preceded by a [illegible] Halley's.

Correspondence.

TOURMALINE DETECTORS FOR NAVIGATORS.

To the Editor of the SCIENTIFIC AMERICAN

In the June 5th issue of the SCIENTIFIC AMERICAN, G. A. H. asks if he can use a tourmaline to reduce the glare of sunlight reflected on water, so as to enable him to detect rocks lying under the water ahead of his boat. Light which has been reflected by water under an angle not very far from 37 deg. is partly polarized, and will therefore be reduced in intensity when passing through a tourmaline properly held before the eye. Light which comes from a submerged object passes easily through the tourmaline held in the position which extinguishes the reflected light. Made with a pan full of water and a submerged stone, the experiment is very successful, but practice alone would show how far the principle underlying it can be successfully applied to the detection of rocks submerged in rough water and observed from a moving boat under variable angles. A Nicol prism would probably prove more useful than a tourmaline. A slice of tourmaline, cut parallel to optical axis, costs about $1.50. A Nicol prism, 8 millimeters square, costs $8.50. Both can be had from dealers in laboratory apparatus. GUSTAVE MICHAUD.

Costa Rica State College.

LIGHTNING

To the Editor of the SCIENTIFIC AMERICAN

Lightning is universally classified as chain, sheet, and ball, of prevalence in the order named, but, as to ball lightning, the recorded instances are so rare and questionable, with no evidence of its electrical nature, I am inclined to say that the information is not sufficient to enable one to form even a belief, much less a judgment, and least of all to formulate a rule respecting it.

Chain lightning has, perhaps, been as thoroughly studied and explained, and is as well understood, as any of the other great phenomena of nature

With respect to sheet lightning, I think the case is altogether different. This designation is given to that diffused illumination, best seen at night in heavy banks of clouds at a considerable distance from the observer, and said to be unaccompanied with thunder

I have long doubted the existence of sheet lightning as a form, having concluded that it is but an appearance, a reflection, of chain lightning occurring behind a cloud, the chain throwing out a diffused illumination, as may be seen from the tongue of an electric headlight of a locomotive on a foggy night

My first and greatest reason for coming to this conclusion is direct observation. I have seen in small clouds, concurrently sheet lightning illumination at one edge and a tongue shoot out from the other In such case, the obscured end of the chain is somewhere on the upper side of the cloud, and as I have observed that the center of the field of the diffused illumination is directly opposite the visible tongue on the other edge of the cloud, I think we are justified in saying that if the chain is not the cause of this illumination, it is nevertheless such an accompaniment as finds therein a full explanation

Another reason which has led me to conclude that sheet lightning is but an appearance, a reflection, from the chain, is, that the illumination always occurs on the upper side of a cloud at a point out of view of the observer, and he sees only the reflection at the margin of the cloud, or in the sky above the cloud, if at a considerable distance, no reason appearing why it should always be thus secluded

The same diffused illumination or reflection may be seen in the sky beyond the horizon on a summer night from lightning occurring at such distances as to be below the range of vision In such instances, the illuminations are always diffused, and the intervals in such perfect accord with our observations of thunderstorms at close range, I see no reason for not saying that they are due to the bolts of Jove.

My own experience confutes the alleged absence of thunder, that occurring only when the cloud is at too great a distance for it to be heard, said to be from ten to fifteen miles. I have frequently heard thunder accompany sheet lightning at close range, although this may still be open to the objection that the chain was playing simultaneously with the sheet, but, if so, it was above the clouds and out of sight.

My reason for calling attention to this at this time is that the mountain-climbing season is now upon us, and if those who ascend to the top report the appearance of the lightning they see in storms below them, and those at the bottom do likewise respecting the lightning observed above them, they can determine the fact very readily.

If what I have said be true, then chain lightning, occurring on the under side of the cloud, will appear to those on the mountain above as diffused light around the edge, or sheet lightning; while the sheet lightning, as seen from the foot of the mountain, will [illegible] a chain by those at the top.

In this manner, the scientific fact could be ascertained, and if you will call attention to it, the present season will doubtless see the determination of the matter A. A. GRAHAM

Topeka, Kan.

FIRST AMERICAN TO CROSS THE CHANNEL THROUGH THE AIR.

To the Editor of the SCIENTIFIC AMERICAN

In view of the admirable though sensational flight of M Bleriot across the English Channel during the past fortnight, and in further view of the reported apathy of those wonderful American aeroplanists, the Wright brothers, toward attempting any similar flight, it may be of interest to your readers who are interested in aerostatics to know that the first flight through the air across the English Channel was successfully accomplished by an American in company with a Frenchman

My authority for this statement is Wise's "Aeronautics," published by John Wise in 1850

This rare and interesting volume, on page 54, chapter vi, contains this statement

"The most remarkable aerial voyage that was made soon after the discovery of aerostatic machinery was accomplished by M Blanchard, in company with Dr Jefferies, an American physician, who was at the time residing in England On the 7th of January, 1785 in a clear frosty day the balloon was launched from the cliff of Dover, and after a somewhat perilous adventure they crossed the Channel in something less than three hours. The balloon after its release rose slowly and majestically in the air, they passed over several ships and enjoyed a grand prospect of the numerous objects below them. They soon however, found themselves beginning to descend, which put them to the necessity of throwing over half their ballast, when they were carried one-third way across the Channel When they got about half way across they found themselves descending again, upon which they threw over the balance of their sand also some books they had with them. All this failed to overcome the gravitating power of the balloon They next commenced throwing overboard their apparatus—cords grapples and bottles An empty bottle seemed to emit smoke as it descended, and when it struck the water, the shock of the concussion was sensibly felt by the aeronauts. Still, their machine continued to descend when they next betook themselves to throwing off their clothing, but having now nearly reached the French coast the balloon began to ascend again and arose to a considerable height without compelling them to dispense with much of their apparel They passed over the highlands between Cape Blanc and Calais, and landed near the edge of the forest of Guinnes not far beyond Calais. The magistrates of the town treated the aerial travelers with the utmost kindness and hospitality The King of France made M Blanchard a present of 12 000 livres, as a token of appreciation of the aeronauts perseverance and skill in the newly-discovered art.

With apologies for my intrusion upon your time but with the hope that the contribution may be of some general interest. P W A. FITZSIMMONS,

Member Michigan Aero Club

THE NUMBER OF OUR ANCESTORS.

To the Editor of the SCIENTIFIC AMERICAN

As to the problem which vexes Mr Venning and Mr Constable, concerning the number of a mans ancestors, allow me to state that their difficulty arises from a false sociologic assumption

They assume that a man must have had four grand parents. This is not so He may have had only two For a long period in human society all daughters of one family were the wives of all sons of the family indiscriminately This "consanguine group" is an established fact in sociology All races, at one time or another passed through it As long as it lasted one's ancestors, no matter how far back he traced them would still be only two.

Hence one can have had 2^x ancestors x generations ago only if we make the x so small that it falls within the time since the consanguine group was outgrown That time is only a petty fraction of the time man has been on earth To establish a rule on what holds true during that fraction, and seek to apply it to the ages that went before, is false reasoning

In present society, however consanguineous marriages having been pretty well eliminated the 2^x rule does hold true. Considering the little corner of time covered by present institutions John Brown, x generations ago, had 2^x ancestors. No doubt about it.

The difficulty in reconciling this mathematical fact with our ordinary conceptions of the matter comes from the implied thought Each of us far enough back, would have had millions of ancestors at this rate. Since there are many millions of us to-day the earth would once have been so thickly crowded as to be simply uninhabitable, which we know was not so.

This difficulty vanishes at once when we remember that such a state of affairs could only exist if every pair of parents gave birth to only one offspring, and each mans ancestors were thus his and his alone. But since the majority of parents produce many more than one child this Simon pure possession of our ancestors all to ourselves is an impossible thing Our ancestors are all inter-owned by the race, each of our forebears is the forebear of a host of others also. And when each man counts up his own individually, those "own" have also been counted up as 'theirs" by hundreds or thousands of others, and any attempted total based on those countings can be nothing but a reduplicated monstrosity

Thus it is true that for modern non-consanguineous times a man had 2^x ancestors x generations ago. But the rule holds good only for those times and within those times the enormous totals urged in disproof of the rule are seen to be purely fictitious.

New York N Y SOLON DE LEON A B.

THE LONG ISLAND PORTAL OF THE PENNSYLVANIA SUB-RIVER TUNNELS

Although the immense improvements undertaken by the Pennsylvania Railway in bringing its lines under the rivers east and west of Manhattan to a station in the heart of New York city have aroused a great deal of popular interest especially on such epoch-making occasions as the meeting of tunnel headings under the Hudson and East Rivers and the recent placing of the last stone of the immense terminal station there is one section of the work of considerable engineering interest which has received very little attention from the press

This is the section just west of the Sunnyside yard on Long Island where the tunnels emerge from the ground, and the point of especial interest is the crossing of one tunnel over another

The object of this cross-over is to bring both east bound tracks to the same side of the station at Sunnyside, no other point being available for such a cross-over without unnecessary complication of trackage at one of the stations.

From the point where it diverges from the present main line near Harrison N J the Pennsylvania's road to New York is a double-track line one track being carried in each of the two tubes under the Hudson to the terminal station at 33rd Street One track and tunnel are used exclusively for west bound and the other for east bound traffic but on entering the station each track spreads out fanwise

The handsome terminal building appears so large from the outside with its half a million cubic feet of granite—1 140 carloads—27 000 tons of steel and 15 000 000 bricks that it is a little difficult to realize that much the greater part of the station proper is underground The underground area of the station is about 28 acres and includes 16 miles of standing room for trains on 21 different tracks, adjacent to over 4 miles of passenger platforms.

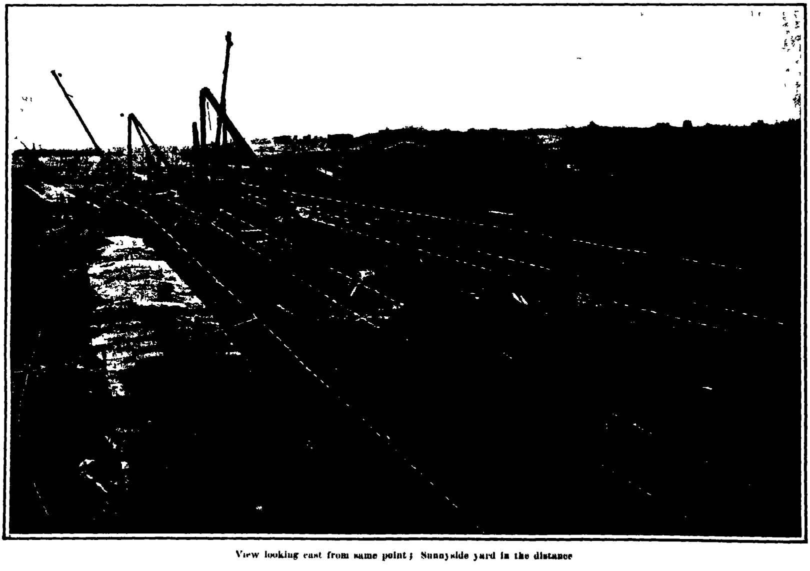
From the station eastward the tracks converge again into first 6 and then 4 tracks carried in two wide tunnels underground and four single-track tunnels under the East River

To bring the east bound and west bound tracks into their natural alternate order as the 21 tracks converge leaving the station would obviously cause a great complication of trackage and the same would apply to an only slightly less extent at the Sunnyside yard A cross-over could not conveniently be made in rock tunneling and less so under the river, so the place selected as most convenient was the "cut and cover' sections between Avenue A and Sunnyside.

The tunnels are now complete all the way from Bergen Hill N J under both rivers and Manhattan Island to Avenue A Long Island City and the section including Sunnyside yard and the cut and cover concrete tunnels for several hundred feet west of it is also practically complete The latter is shown in one of our illustrations, the position of the completed portions of the tunnels being shown in dotted lines and the retaining walls of the cuts where the tunnels emerge being visible in the distance on the left of the picture Along the left side of the picture is the brick-covered concrete top of the A or northernmost of the four river tunnels, which is now complete all the way to the Manhattan terminal The next section westward where the cross-over is being made is shown in our other illustration On the left in the distance where clouds of steam may be seen arising drilling is still in progress for further excavation of rock to make room for D tunnel (the southernmost of the four) the completed part of which is hidden by the massive shoring supporting the ground under the Long Island Railroad tracks seen in the picture The material excavated here is hoisted by the numerous cranes shown and used to bury A tunnel on the right of the picture High in the middle the concrete lining of C tunnel may be seen having been carried up to that level at a gradient of 1.9 per cent from the bulkhead line below which in the river all four tubes are at the same level the other three rising to the point shown at only 1 22 to 1.26 per cent

View looking west at Pennsylvania Railroad tunnels as they near the surface in Long Island City

The view shows the point where the tunnels [illegible] River near the Long Island portal



View looking east from same point; Sunnyside yard in the distance

On the left is seen the brick covered concrete top of one completed tunnel; dotted lines show position of completed portions of the others, to be joined to those shown in course of construction in other view

THE LONG ISLAND PORTAL OF THE PENNSYLVANIA SUB-RIVER TUNNELS.

Low in the foreground may be seen the entrance to B tunnel, which has now crossed under C to assume the relative position occupied farther back along the line by C tunnel.

Immediately behind the pile of earth on the right of the picture is the portal of the Steinway Belmont tunnels, leading under the river to the New York Central station.

An idea of the massive nature of the work may be formed from the size and number of the shores required to hold up the outer forms of the upper tunnel

The work is being covered up as fast as completed and about a year from now as passengers are carried through the tunnels, they will probably be unconscious even of the difference of gradient between tunnels B and C, and there will be no evidence on the surface of the immense work here shown of carrying one tunnel over the other

* * *

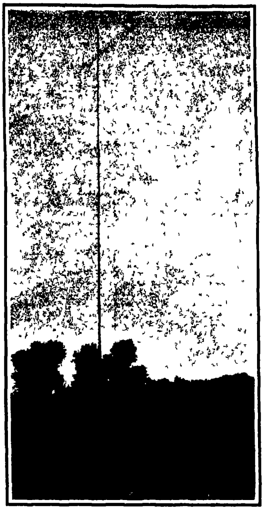
AN AUTOMOBILE WIRELESS TELEGRAPH STATION

The officers of the telegraph corps of the French army have been experimenting with an automobile wireless telegraph station Externally, the vehicle resembles a limousine of the ordinary type. The wireless apparatus is not conspicuously visible through the glass windows The mast, its base, and the winch by which it is raised are carried on the roof of the car and covered with an awning The car, all parts of which are movable, is divided into two compartments. The forward compartment contains the sparking coil and other dangerous instruments, the rear compartment contains a 5-horse-power dynamo, the receivers, the operating key, and a comfortable seat

The car and apparatus weigh 6 160 pounds. The weight is increased to 7 260 pounds by the addition of the crew of six men with their baggage. The car is driven by a motor of 22 horse-power, and can maintain a speed of 26 miles per hour on a level road, and more than 6 miles per hour in ascending a grade of 14 per cent.

The antenna is set up very easily and rapidly, owing to the ingenious telescopic construction of the mast, which, when lowered, consists of a number of concentric metal tubes about ten feet in length The central and smallest tube incloses a steel wire about ¼ inch in diameter, coiled very closely into a helix so that it resembles a strongly compressed spiral spring, or the wire wrapping of a rubber hose The wire similarly coiled is extended into the base of the mast where it is gripped by two pairs of wheels which are operated by cranks and gearing By this mechanism the wire is forced upward, carrying with it the central tube, which, when extended to its full height, draws after it the second tube which in like manner draws out the third tube, and so on Although the elevation of the smaller tubes leaves the lower part of the wire inclosed in larger tubes which allow it to bend slightly it remains sufficiently stiff to keep all the tubes practically vertical

The mast with its aluminium support, weighs about 400 pounds. The telescoped mast is first screwed to its base and then raised to a vertical position by four men. A few seconds' work at the cranks then extends it to a height of 66 feet. The five wires of the antenna are attached to the top of the mast. Four of these wires, each about 160 feet long are distributed at equal angular distances around the mast and are attached to the ground by other wires, insulated from them, so that the lower ends of the antenna wires are about 26 feet above the ground The fifth antenna wire is connected with each of the others and is extended through a hole in one of the glass windows of the car to the apparatus inside The mast is also anchored to the ground by stays attached below the summit When the antenna has been set up the motor is geared to the dynamo only 3 horse-power being usually employed


The mast fully extended

The station can be made ready for operation in six minutes Its normal radius of action exceeds 30 miles As two men suffice to operate it continuous service can be assured by dividing the crew of six men into three watches of eight hours each

The French army already possesses wireless stations drawn by horses. Each station comprises two wagons one of which carries twelve men and a gasoline motor It takes half an hour to set up one of these stations and the radius of action is only about 60 miles. Nevertheless the *stations are superior to* those of the German army the installation of which occupies 45 minutes with a greater number of men. The *French* army is the only one that possesses an automobile wireless station

The installation of wireless stations on dirigible balloons has been contemplated but the problem presents an almost insuperable difficulty The highly charged antenna by its inductive action on the wires by which the car is suspended from the balloon would cause sparks which might ignite the hydrogen which escapes from the staunchest of gas bags. The danger could be diminished by substituting non metallic ropes for the steel wires but even the ropes would become conductors when wet

This danger does not exist in the case of aeroplanes It is estimated by experts that the total weight of an aerial wireless station need not greatly exceed 100 pounds The station could be operated by one man in addition to the aeronaut The day—apparently not very distant—when an aeroplane shall carry the weight of three men will soon be followed by the combination of those two present marvels—wireless telegraphy and mechanical flight

* * *

Making Briquettes.

Briquette making formed the subject of a paper recently read before the South Wales Institute of Engineers by Prof W Galloway Small coal, as is well known cannot be burned so economically in the furnaces of boilers in its original state as when in the form of briquettes Briquettes made exclusively with anthracite coal burn too slowly and it is advisable to mix a certain proportion of bituminous coal to overcome this objection Up to the present no kind of agglomerating material other than pitch or resin or a mixture of these has given satisfactory results. Briquettes made with resin alone become soft and lose their shape in the fire those having a mixture of 4 per cent of pitch and 1½ per cent of resin give better results It is of interest to note that the total output in the United Kingdom in 1906 amounted to 1 513,220 tons, while Germany produced 14 500,851 tons of this fuel in the same year The paper contains full descriptions and drawings of the mixing and drying machinery and presses required for briquette making together with estimates of labor required and costs For example at an English works making 102½ tons of briquettes per day of ten hours the total cost including labor materials fuel and stores interest and depreciation works out to 9s 7 45d per ton

* * *

The linking of India and Ceylon by railway is again under discussion There is said to be no serious engineering difficulty connected with the bridging of the Paumben Channel nor at the south end of the line, for the island of Mannar is already practically attached to Ceylon But between the southern end of the island of Rameswaram and the northern end of the island of Mannar there is a distance of about 18 miles marked by an almost continuous coral reef either covered with shallow water or rising above the level of the sea in numerous coral islets—the stepping-stones' of Adam s Bridge—to be bridged

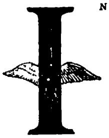
An automobile wireless telegraph station.

Erecting the telescoping mast.

AN AUTOMOBILE WIRELESS TELEGRAPH STATION.

THE HEAVENS IN SEPTEMBER.

BY HENRY NORRIS RUSSELL, PH.D



IN the present month the event of the greatest astronomical interest is the very favorable opposition of Mars, which occurs on the 24th All through September the planet is very near us—from 36 to 37 million miles, and is better placed for telescopic study than it has been for us since 1892

Oppositions of Mars are frequent enough—about once every two years and two months but as its orbit is by no means circular its distance from the sun may vary from 128 to 154 millions of miles Taking the earth's distance from the sun as 93 millions the distance between the two planets when in line with the sun may vary all the way from 35 to 61 millions of miles

At the present time conditions are almost ideally favorable Two years ago it is true Mars was almost as near us as he is now but then he appeared so far south in the heavens that he could hardly be observed in our latitude while in England as one of the Greenwich observers aptly said he hardly rose above the tree tops This year he is almost on the equator and it will not be necessary as it was then to go far south to observe him at a proper altitude

Being so near us he appears unusually large in the telescope and very bright to the naked eye fairly rivaling Jupiter and surpassing all else in sight so that one has but to look at the sky to find him

Of course this good opportunity will not be lost by those astronomers who make a study of planetary detail What they may discover we will know later at present it may be worth while to speak a little of the conditions under which the work must be done

Mars at his best looks only about 1/75 as big as the moon (with the same magnifying power) On account of the unsteadiness of our atmosphere (which makes everything seen through it appear to dance about and be more or less blurred) it is only under very favorable circumstances that a magnifying power much greater than 1,000 diameters can be used That is it is only on these rare occasions that we can see Mars as well with a great telescope as we can see the moon with a good binocular or spy glass magnifying 13 times Under ordinary conditions the bad seeing would make it impossible to see anything like as much on Mars with the big instrument as can be seen on the moon with the small one

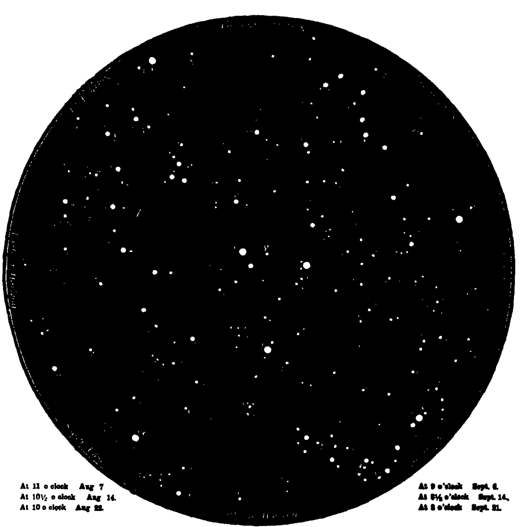
The same difficulty affects photography The image of Mars with the same telescope is only 1/75 as big as the moon's but the grain of the plate is of the same size If we try to enlarge the planet's image by auxiliary lenses we lengthen the exposure time so that the image is blurred by bad seeing The remarkable results obtained at the Lowell Observatory were gained by a judicious choice of enlarging power combined with a very favorable climate and great manipulative skill

Even if our air was by a miracle quite steady there is a limit to what we can see on Mars No telescope however perfect can make the image of a star a mere luminous point as geometrically it ought to be This arises not from the character of the lenses mirrors etc but from the very nature of light Knowing that light consists of wave-like vibrations it is possible to show (by methods too technical to be briefly explained) that the image of a star seen through a round opening like that of a telescope will not be a sharp point but a small disk of light fading away gradually at the edge and surrounded by much fainter rings of light. Similarly the image of a straight line is not a similar line, but a streak of definite width, bordered by much fainter streaks. The larger the aperture of the telescope, the smaller will be these spurious images. By stopping down our lens to one-half its size, we make them twice as big, and so on

Their actual size is very small. With the great Yerkes telescope the spurious disk of a star is about 1/2400 of an inch in diameter. But on the image of Mars at its nearest, this corresponds to nearly 20 miles on the planet's surface

Nothing much smaller than this can be seen clearly with any existing telescope, even under ideal conditions A narrower black line would seem blurred out into a gray fuzzy streak—much like a photograph out of focus, as regards appearance, though quite different optically—and a black dot into a faint gray patch.

It is of course one of the first duties of an observer to learn to recognize these spurious images, and distinguish them from real ones and also to attempt the more difficult task of seizing the moments of good seeing between the disturbances of the image due to our atmosphere But the fact remains that we cannot see clearly anything less than 20 miles across upon Mars (or anything much less than 50 miles, except with a very few instruments) and that therefore any visible evidences of life or of intelligent construction on the planet would have to be on an enormous scale.



NIGHT SKY: AUGUST AND SEPTEMBER

THE HEAVENS.

Right overhead at our hour of observation is Cygnus one of the finest of the constellations. Our initial letter shows the figure of the Swan flying southward along the Milky Way, with the star β marking its head, the line $\zeta\ \epsilon\ \gamma\ \delta\ \kappa$ (the last not on the map) its wide-spread wings, and with α, the brightest of all, in the midst of its body

Two or three stars in it deserve special attention. α is notable because the most careful measures of its parallax fail to give a sensible result. This star, though apparently one of the brightest in the heavens, is at a literally immeasurable distance Its real magnitude must be exceedingly great.

β is a fine wide double, yellow and blue, also at a very great distance

Most interesting of all is the small star 61 Cygni (marked on the map) which is just easily visible to the naked eye This is the first star whose distance was measured (by Bessel in 1838) Numerous recent measures have determined its parallax and distance with an uncertainty probably less than five per cent. Its distance from us is 10¼ light years, or 62 millions of millions of miles. At this distance the sun would look about as bright as the pole star now does to us. 61 Cygni appears to the eye only about 1/10 as bright as this. As it is a double star, neither of the two can be 1/10 as bright as our sun. They are in slow relative motion, which in the last century has shown very little curvature, but it is pretty certain that they are really moving in a vast orbit, whose circuit may occupy a thousand years or more.

West of the zenith, and high up, is the brilliant steel-blue Vega, and in the south is Altair, which is about one-half as bright. Above the latter are the small groups of Delphinus and Sagretta, and below are Capricornus, with its familiar double stars, and Sagittarius. Scorpio is setting in the southwest, and Ophiuchus is above it. Hercules and Corona are below Vega, and Arcturus lower still, almost due west. The Great Bear is low in the northwest, with the Little Bear and Dragon above her

In the northeast Cepheus is high above the pole, Cassiopeia below, then Perseus, and lastly Auriga, which is just beginning to rise. In the east is the great square of Pegasus, with Andromeda on the left and Aquarius on the right.

The solitary star in the southeast is Fomalhaut. The very bright object a little south of east is Mars, and the fainter one about half way between this and Aries is Saturn.

THE PLANETS.

Mercury is evening star all through the month and is visible in the first half of it, setting about 7 20 P M. on the 1st, and 7 P M. on the 15th. He is at his greatest elongation on the 17th, when he is 26 deg. east of the sun, but being also some 11 deg. south of it, he is not very favorably placed.

Venus is evening star, setting about 8 P M on the 1st, and is moving rapidly southward so that on the 30th, though farther from the sun, she sets at about 7 20

Mars is in Pisces, and comes to opposition on the 24th He is visible all night long, and is exceedingly conspicuous During the month he moves slowly westward among the stars and at its end he is quite near the "first point of Aries" from which longitudes and right ascensions are measured, being about 4½ deg. south of it.

Jupiter is in conjunction with the sun on the 18th, and practically invisible all through the month

Saturn is in Pisces, and rises about 7 30 P M on the 15th, so that he is observable most of the night.

Uranus is in Sagittarius and crosses the meridian at 7 37 P M. on the 15th.

Neptune is in the constellation Gemini, and rises a little after midnight.

THE MOON

Last quarter occurs at 3 P M on the 6th, new moon at 10 A. M on the 14th, first quarter at 1 P. M. on the 22nd, and full moon at 8 A. M. on the 29th. The moon is nearest us on the 1st and again on the 29th, and remotest on the 16th.

On the evening of the 1st she is in conjunction with Mars, and as seen from the eastern United States, passes right over him, hiding him for nearly an hour This will be a most interesting affair to watch

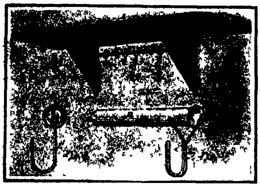
As seen from Washington, Mars disappears at the eastern side of the moon at 8 42 P M., and reappears almost at the opposite point, at 9.39 These times will be earlier for places west of Washington, and later for those east of it, *after allowance is made for the difference between standard and Washington time*

The moon is also in conjunction with Saturn on the 2nd, Neptune on the 9th Jupiter on the 14th, Mercury on the 16th, Venus on the 17th, Uranus on the 23rd, Mars again on the 28th, and Saturn on the 30th; but these are of less interest, though the second conjunction with Mars is close, and an occultation is visible in South America.

Patent Department

SHEET-METAL SHELF

Pictured in the accompanying engraving is a shelf formed of sheet metal, which is so arranged that it may quickly be attached to a wall or other support, and as quickly detached and folded compactly for storage or transportation The shelf proper consists of a sheet metal piece *A*, provided with depending flanges The brackets *B* are pivoted on pins *C* which are journaled in the flanges of the shelf The brackets are also provided with flanges at the rear end with holes for screws, with which the shelf is attached to the support. The brackets also support a pair of bars *D*, from which hangers *E* are suspended The end of each bar is flanged outwardly as indicated in Figs 2 and 3 The brackets *B* are formed with openings *F*, shaped like a keyhole, that is with an enlargement above to admit the flanged ends of the bar *D* and a constricted portion for the body of bar which is kept from slipping out by the flanged ends The hangers *E* are formed of a single length of wire bent double as shown to the best advantage in Fig 3 The ends of the hangers are formed with rings *G* The bars *D*, which are hollow, are slotted lengthwise and the ends of the hangers are introduced into this slot while the rings *G* prevent them from slipping out. Either one or both bars may be used and the hangers provide convenient support for various articles It will be evident that the device may be folded up in a moment's time, the brackets lying within the flanges of the shelf *A*, so that the device occupies a minimum space The inventor of this device is A Dahl of 302 West 144th Street, New York city

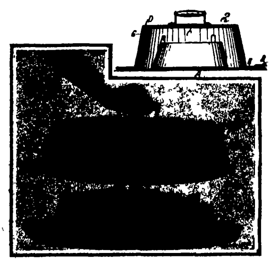


SHEET-METAL SHELF

◆

SAD-IRON HEATER AND RECEPTACLE

When heating sad irons on oil and gas stoves there is danger of the irons becoming coated with soot, owing to their direct contact with the flames In order to overcome this difficulty the sad iron heater illustrated in the accompanying engraving has been designed. It consists, in general of a plate or tray adapted to rest on the stove and a cover formed with a double wall in which insulating material is placed In this way the flames are prevented from touching the irons, while the cover prevents the escape of the heat from the inside, and thereby accelerates the heating of the irons. In the engraving, the tray is indicated by the letter *A* The rim of the tray has an extension *B* at one side, formed with a slot. The construction of the cover is clearly shown in the sectional view. It comprises an inside wall *C*, and an exterior wall *D*. The wall *C* is formed with a flange *E*, at the lower edge, on which the edge of wall *D* rests. At one side the flange *E* is extended to form a tongue *F* Between the two walls of the cover, a layer of asbestos *G* is placed This layer is placed only at the top of the cover, leaving an air space between the two walls at the sides as shown The handle of the cover is attached thereto by means of bolts which pass through to the interior wall *C* and serve to clamp the two walls together When the device is not in use the tongue *F* is slipped through the slot in the extension *B*, and the whole device may then be hung on a hook passing through an opening in the tongue The inventor of this improved sad iron heater is Mr Frederick W Wantzel of Rossmere Lancaster Pa.

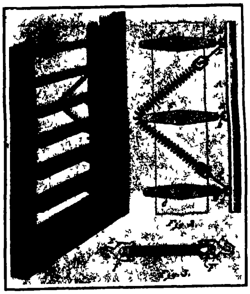


SAD-IRON HEATER AND RECEPTACLE

◆

SLAT ADJUSTER FOR WINDOW BLINDS

The ordinary window blinds are not provided with any means for holding the slats open or closed other than the friction of the slats themselves. When the slats work loose they are apt to close or open of their own weight or under action of the wind and in stormy weather they are quite apt to rattle. This difficulty is overcome by using a device such as illustrated in the accompanying engraving In the sectional view Fig 2 the slat rod is indicated at *A* It is provided with the usual staples *B* to which the slats *C* are secured by means of hooks or staples *D* The slat adjuster consists of a coil spring which passes over the end of one of the slats *C*, and is attached at each end to the staples *B* by means of hooks *E* The tension of this spring is made adjustable by means of a U-shaped clip *F*, which is provided with fingers that engage the coils of the spring as shown in Fig 3 The hooks *E* are caught under the clips and are free to adjust themselves to the various positions of the spring as the slats are moved to open or closed position If desired an ordinary coil spring terminating in a hook at each end may be used as indicated in Fig 1 but the adjustable spring is preferred as it may be fitted to slats of different sizes and the tension may be regulated to a nicety With the adjuster in place the slat bar is held tightly against the slats preventing it from rattling and the springs also prevent the slats from moving up or down after they have been set in a certain position The inventor of this device is Mr Ernst W F Herrmann, 314 Pas Hondo Street San Antonio, Texas

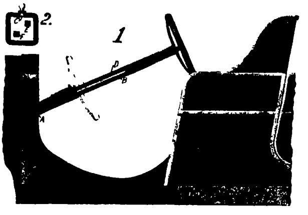


SLAT ADJUSTER FOR WINDOW BLINDS.

◆

TELESCOPIC STEERING GEAR.

The most suitable position for the steering wheel of an automobile is to have the wheel close to the chauffeur's seat and on an axis that lies at about twenty three degrees from the horizontal or even less. Unfortunately with the steering wheel in this position, it is awkward for the driver of the machine to get into or out of the seat. Furthermore the steering column acts as a bar to prevent occupants of the automobile from mounting or alighting from the machine on the chauffeur's side To overcome these objections and yet keep the steering wheel at the most suitable angle, a telescoping type of steering column has recently been devised As shown in the accompanying engraving, the steering column comprises two hollow members of approximately rectangular form (see Fig 2), the member *A* being connected to the steering gear in the usual manner while the member *B* which carries the steering wheel, is arranged to slide within the member *A* It is not essential that the two members be of rectangular form, but any other form will do, hexagonal, for instance, or oval, which will do away with the necessity of keying one to the other In Fig 1 the position of the wheel when the steering column is telescoped is indicated by dotted lines. The steering column may be extended to any degree desired by the driver of the machine and locked in this position by a spring pressed pin *C* on the member *A* which is adapted to enter any of the perforations *D* spaced at regular intervals along the member *B* Within the member *B* are the connections *E* and *F* running to the spark device and throttle control These connections are also of telescope construction, as indicated in Fig 2 The inventor of this telescoping steering gear is Mr C J Schoening Box 112 Honolulu H I

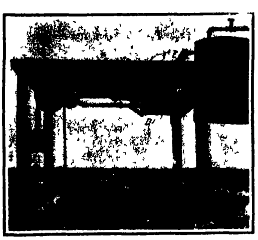


TELESCOPING STEERING GEAR FOR AUTOMOBILES

◆

WAVE AND GRAVITY MOTOR

A recent patent describes a new form of wave motor in which the power of the waves of the sea or ocean is utilized alternately with the power of gravity to operate an air compressor The compressed air is stored in a reservoir and may be piped to any point desired, so that the energy of the waves may be utilized at a considerable distance from the ocean The apparatus comprises a platform built out over the water A pulley *A* is attached to the under side of the platform and a rope which passes over this pulley is fastened at one end to a large caisson or float *B* while the other end carries a counterweight *C* The float rises and falls under action of the waves and the weight keeps the rope taut The pulley is thus rotated back and forth by the action of the rope thereon The pulley shaft is geared to a crank shaft which operates the two pistons of the compressor The two cylinders *D* of the compressor are provided with valve-controlled outlet passages which communicate with a common pipe *E* connected to the reservoir *F* The weight and float are so proportioned that a lowering of the water level causes a lowering of the float and a raising of the weight while when the water level rises the weight is sufficiently heavy to cause a positive rotation in the reverse direction of the pulley shaft. Thus the weight rotates the shaft in one direction by gravity and the float rotates the shaft in the opposite direction when the waves recede To simplify the construction the cylinders *D* are left open at one end and no inlet valve is provided other than the piston washer A very simple form of outlet valve is used consisting of a conical plug which is lifted by the compression of the air in the cylinders but is prevented from rising too far by a hooked stem which engages the lower end of the valve A patent on this wave and gravity motor has been secured by Mr Allen T Ransom 44 Scholes Street Brooklyn N Y



WAVE AND GRAVITY MOTOR

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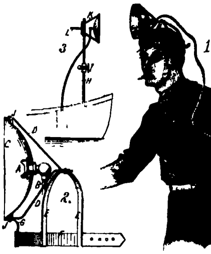
In 1907 the United States produced 166 000 000 barrels of oil and in 1908 according to unofficial estimates the total was more The United States produces 63 12 per cent of the entire oil production of the world

A PORTABLE LAMP

A very convenient form of lamp has recently been devised for the use of campers hunters, etc. It consists of a portable acetylene gas generator, and a burner arranged within a reflector which is open at the front for the escape of heat. The walls of the reflector are imperforate to prevent the passage of air through the reflector when the lamp is being moved about or is exposed to the wind In this way the danger of extinguishing the light is avoided The accompanying illustration shows in Fig 1 how the lamp may be attached to the head of a man while the gas generator is secured to his belt The details of the head attachment are shown in the sectional view, Fig. 2. The burner *A* is attached to the flexible tube *B*, which runs to the generator The reflector *C* in which the burner it fitted is provided with a flange along its outer edge, to which the arms *D* are secured These arms are fastened to a cage *E* provided with a strap *F*, which is strapped about the head of the wearer As an additional support to the lamp, a small bracket *G* connects the bottom of the reflector directly to the head strap When it is desired to use this device on a boat or in camp, it is mounted on a stand *H*, as indicated in Fig 3 This stand is formed of two sections, one of which is hinged upon the other so that the lamp may be moved laterally By means of a thumb screw *I*, the two sections may be clamped at any desired position The lamp is taken out of the head gear by unscrewing the bolts *J* and it may be then fastened in a bracket *K*, which is swiveled on the upper end of the stand The swiveling bracket is provided with a handle *L*, which enables one to move the lamp about in any desired direction The inventor of this portable lamp is Mr O A Loveless of Waters Meet Mich

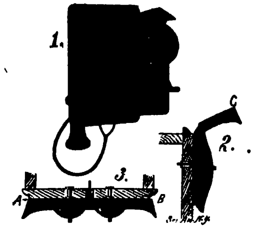


A PORTABLE LIGHT FOR CAMPERS.

◆

RESONATOR FOR TELEPHONES.

Pictured in the accompanying engraving is a device adapted to augment the sound of telephone bells or other signals so that the signal may be heard in places where there is more or less noise The device is particularly adapted for use in shops, pumping stations, and the like where ordinary sounds are not discernible especially under heavy atmospheric conditions or in damp or rainy weather The device consists of an elongated dished body formed with sound reflectors at opposite ends and a similar sound reflector overhanging the center of the body This device is placed behind the bells of the telephone and acts to reflect the sound in a definite direction The reflectors referred to are indicated at *A* *B* and *C* in the illustration. It will be observed that they are of conical form, and the reflectors *A* and *B* serve to catch the sounds which ordinarily travel out in a lateral direction from the telephone, and direct them forward The reflector *C* serves similarly to collect and reflect the sound waves that pass upward. For convenience in manufacture the reflector *C* is preferably made in a separate piece, but the portion which extends to the main body is tangent thereto and flattened, in order that a neat joint with the body may be effected The device is extremely simple, and can readily be attached to a telephone by means of a couple of screws. The form of the reflector can be modified to throw the sound to one side if desired instead of directly forward The inventor of this resonator is Mr Patrick E Finlay of New Orleans, La (No 2 St Louis Pumping Station)



RESONATOR FOR TELEPHONES.

RECENTLY PATENTED INVENTIONS

Electrical Devices.

ELECTROLYTIC CELL. J McPhail, Carteret N J The inventor seeks to construct an electrolytic cell in which there may be brought about a complete separation of the products with a minimum of undesirable by products, the cell occupying a comparatively small space and being simple and easily handled

TELEPHONE ATTACHMENT R F Derrick, New Albany Ind In view in this case is the provision of a construction comprising a bracket and a frame for carrying the receiver of the telephone swingingly mounted on the bracket and adapted to rest on the circuit controlling arm of the telephone when swung to a depressed inoperative position and release said arm when swung upright in position for use

Of Interest to Farmers.

DUMPING VEHICLE – F Busch and C G Glasrud Sheyenne N D The invention relates more particularly to a vehicle having a running gear of any suitable type a frame rigidly carried by the rear axle of the vehicle and a wagon body mounted upon the frame the rear axle serving as a pivot to permit the body to be tilted so that its contents can be dumped

INSECTICIDE –J W Woods Portland Ark The ingredients composing this destroyer are to be thoroughly mingled by agitation and applied to the plants infested with boll weevil or other insects by sifting the same over the plant The compound may also be applied to the infested plants in any other desirable manner

COMBINED BED SHEET AND SHELTER TENT F Whitney Cimarron New Mex The sheet is for use by stockmen which may be quickly supported in the form of a shelter tent, the device being so constructed that it can be readily packed for transportation and which is complete in one piece with ropes attached so that it may be adjusted with supports as a tent or when desired may be used as a bed sheet the stockman having the complete device in compact form at all times except the supports which can readily be obtained

Of General Interest

BEER TAPPER R H Stiles Washington D C The tapper is of that form in which a bung casing is screwed into the head of the barrel and is provided with separate ports, through one of which compressed air is admitted to the barrel while beer is drawn out through the other With this form a detachable coupling bearing separate tube connections, for the air and beer is arranged to be turned into the casing and in the movement to operate a valve which simultaneously opens or closes the air and beer ports

METAL-DEPOSITING APPARATUS I K Reynard East Elmhurst N Y It has been found that the distinctness of the sound produced by phonograph records is much increased by depositing upon the wax a fine layer or film of metal previous to electro-plating The metal preferably used is gold The invention reduces the consumption of gold and preserves a perfect seal for the vacuum chamber in which the depositing operation takes place.

BOX W L Howland, Cedar Rapids Iowa In the present invention the improvement pertains to boxes and has for its object the provision of a box preferably made of wood which while strong can be easily and cheaply manufactured and may be quickly put together by the user when desired

METHOD OF TREATING WOOD DURING DISTILLATION H W Doughty, Amherst Mass In this instance the intention is to provide a new and economical method of utilizing the waste from resinous pine wood in the form of saw dust mill-chips etc to recover in commercially valuable forms the various constituents of such wastes

CONCRETE MOLD R N Neil Cozad Neb One provision in this case is that for a mold with side members which are connected by spools supported by rods disposed therein the spools having hollow heads in which the rods are screwed there being additional threads in recesses in extremities of the heads in which nuts having orifices are adapted to mesh means in the heads preventing the rotation of heads on bolts which are disposed on the orifices in the nuts

ENVELOP FASTENER.—J E. A Thollander Piedmont Fla An object here is to provide a fastener which can be applied to any common form of envelop which prevents the unauthorized opening of the envelop without leaving traces of such an act which is inexpensive and which adds but slightly to the weight or bulkiness of the envelop.

Hardware.

SHADE-BRACKET H Wittmann Cincinnati Ohio In this patent the invention is an improvement in curtain fixtures and has for an object among others to provide a novel construction by which the brackets may be readily applied and adjusted to suit any suitable length of curtain and then clamped in position

FOOT REST FOR SHOE-SHINING STANDS G F Oliver and R Rousseau Ilion N Y The invention pertains to foot rests such as used at shoe shining stands for supporting the feet when the shoes are being polished The object is to provide a rest which will operate to hold the foot rigidly in position and at the same time permit the sides of the shoe to be exposed

DOOR LOCK G W Northrup Brainerd Minn This invention refers to door locks of the class known as mortise locks, which are embedded in a door by forming a recess in the body of the door from the free edge inward The purpose is to provide a lock of simple construction and while possessing all the advantages of the mortise lock may be placed on thin doors or those of greater thickness.

MITER BOX F W McLean West Monroe La The patentee has for his object the provision of a device which is light and compact, and one that will permit the use of an ordinary hand saw by drilling a single hole therein, and with which the full length of the saw will be utilized

SASH LOCK —L H Gray San Francisco, Cal The invention may be defined as consisting of a bolt insertable in the overlapping portions of the sash frames at each corner the bolts passing from the inside through the lower sash into the upper sash and guard plates movable over the heads of the bolts to prevent the bolts from being punched out from the outside of the window

Heating and Lighting.

PREHEATING LIGHTING-FIXTURE. — W N Best Sr New York N Y The invention relates to improvements in fixtures and more particularly to that type in which combustible gas is burned and the products of the combustion of the flame are delivered to the interior of an inverted mantle The device supports the mantle and permits the gas to be heated to a high temperature before it is burned and before it is delivered to the mantle

REMOVABLE FURNACE-OVEN — N F Storms, Minneapolis, Minn The object here is to provide an oven for removable attachment to a furnace or regular heater to permit using the oven for baking and other purposes and without placing the oven and its contents directly over the burning fuel in the fire-box or subjecting the contents of the oven to the action of the obnoxious gases incident to burning of the fuel in the fire box

THERMOSTAT W Enterline, Big Run Pa Mr Enterline's invention relates to a thermostat which may be disposed against a boiler and which while inexpensive to construct may be readily adjusted to a boiler of any type and will automatically and accurately regulate the supply of gas which is supplied to the burner under the boiler

Household Utilities.

REGULATING VALVE —H C Benwitz Chicago, Ill The invention is an improvement in regulating valves for the hot and cold water supplies leading to wash stands, bath tubs, and other similar places. The valve includes an actuating lever or handle which is operable not only to control both the hot and cold water supplies but also to control the water or outlet

MEASURING APPARATUS. R. Hoyt, New York N Y The invention pertains to apparatus for measuring various materials it being particularly useful in connection with packaging machines in which it is desired that a measure by weight shall be quickly made and with substantial accuracy

STRAIGHTENING MACHINE E A Lake, Fulda Cal The invention refers to machines for removing bulges, dishes, dents, and the like from metal especially from band saws, and relates more particularly to a machine having removable rolls, one of which has an annular concave part spaced inwardly from the edges of the roll whereby the latter has flat parts at each side of the concave part, and a second roll having at each side of the convexed part flat portions.

CHANGEABLE SPEED GEARING — W Scott, Sheridan Wyo One object of the improvement is to supply a gearing more especially designed for use in the driving mechanism of automobiles and other machines, and arranged to enable the operator to use any one of four different speeds for driving ahead and a single speed for driving backward.

HOISTING-MACHINE. — C F Dallman, Antigo, Wis. The machine is for use whenever a hoisting drum is desired for raising or lowering loads, power being applied through a shaft, which through its connection with a second shaft rotates the gear wheels at each end of the drum Mechanism is arranged to operate the drum from a distance the operation of the drum being the same whether it is manipulated directly by a bar lever or intermediately by the three-armed lever

HYDRAULIC GOVERNOR.- A Dickerson, American Fork, Utah In this mechanism which in part is operated upon the same general principle as in the steam governor formerly patented by Mr Dickerson, the hydraulic piston constitutes an automatic check to the movement of the whole gate mechanism The gate follows every move of the governor and if there is any change of pressure of water on the gate the whole will automatically readjust itself without necessitating a change in the speed of the engine

MACHINE FOR MAKING MACARONI AND THE LIKE --J Rivara Natchez, Miss. The aim in this case is to simplify the construction of machines of the pastry class and to adapt the screw which operates the plunger or piston, to be quickly withdrawn from the cylinder in which dough or other material is pressed to produce macaroni or other product

YARN PRINTING MACHINE — N Costikyan Leicester England. The intention of this inventor is to provide a machine for use in printing warp yarns, especially carpet or pile yarns, according to a predetermined pattern and arranged to permit printing at one operation as many knots or spaces as desired and in one or more colors

Machines and Mechanical Devices.

DUMB WAITER OR ELEVATOR —C A Sturm and R N Black Portland, Ore This invention is intended especially to be used where the waiters or cages are operated from a point outside of the cage or waiter An object is to provide means for indicating to the operator when the car has arrived at the end of its travel up or down

AUTOMATIC FIREARM —J J Reifgraber St Louis Mo In operation when the breech block has reached its rearmost position the cartridges may be fed up from the magazine and the block may then move forward with the barrel and the block latch will adjust in rear of the block and travel therewith and with the barrel forwardly locking the block from any rearward movement until the barrel has again been pushed back in position in which the locking latch may be released to release the block

SINTERING MACHINE —A B Young, Salt Lake City Utah One of the purposes in view in this improvement is the provision of a device in which finely divided ore may be brought into a conglomerate mass by a sintering process and then may be delivered free from the machine in blocks of convenient size for subsequent treatment in a blast furnace.

MACHINE FOR MAKING CELLULAR BOARDS. —S M Langston, Camden, N J In the present construction the machine is especially adapted for making asbestos board, and involves mechanism for pasting together two sheets corrugating the combined sheets, heating them to dry the adhesive material and retain the corrugations in permanent form and then securing a third sheet to the [illegible] of the corrugations of the double corrugated sheet.

ELEVATOR.—E. C. Foster, Telluride, Colo. The invention is an elevator for water, slimes, grain, and other fluid matter, and provides a machine which will do a large amount of work with comparatively small power and contains no valves or other parts apt to wear out or get out of order, and which is capable of use at any inclination from vertical to horizontal

MACHINE FOR MAKING CARTONS.—S M Langston, Camden N J This invention pertains to certain improvements in machines for making cartons, and more particularly for making that type of carton in which a strip of sheet material is bent to form a tube and in which the meeting edges are secured together by a strip of tape or the like.

STEAM HAMMER.—T R. Holmes 8 Oakdale road, Sheffield, England In this invention the object is to provide improved controlling gear whereby to render a self acting hammer more perfectly amenable than heretofore to the will of the operator so that the latter will be enabled to regulate with greater certainty than hitherto, the frequency intensity and length of stroke of individual blows

VARIABLE-SPEED GEARING.—J Heim, Winnipeg Manitoba Canada. The principal object in this invention is to provide a plurality of non rotatable gear members, any one of which may be brought into engagement with a rotatable gear member to cause a rotation of the latter as it moves bodily along the face of the stationary member

LOOM TEMPLE.—A Fortuna Manchester, N H. This invention prevents unequal wearing of the slide bar and tipping even when the bar is already worn When worn so that there is a tendency of the bur roll to tip downwardly at its outer end a bar is lowered toward a lateral lug to correct tipping after which it is secured by a set screw Means assist in supporting the torsional pull and making the leverage of resisting force more nearly equal to that of the opposing force

DRILL AND CUTTING MACHINE.—E. A Cunningham Oskaloosa Iowa This mechanism includes a rotating bit and is arranged so that the bit is normally free to travel forward slowly as it turns, but is stopped or checked automatically in its forward travel whenever it encounters an obstacle unusually hard to penetrate yet the bit is free to travel rapidly forward when the boring through the unusually hard obstacle is complete

AIR SHIP.—C J Bretuel Pinctown, N C The wings of the aeroplane spread a greater distance transversely to the line of flight than the fore and aft distance This follows the analogy of the wings of a bird and founded on the principle of physics essential to successful aeroplanes, which secures a short transverse impact of the wings upon the relatively still air whose inertia gives the resultant upward pressure to buoy up the aeroplane and allow quick clearance of the air in the rear

Prime Movers and Their Accessories.

METHOD OF UTILIZING HEAT OF COMBUSTION AND STEAM POWER IN PRIME MOVERS.—T Schtschiebrakoff Moscow, Russia In this apparatus an internal combustion chamber is inclosed within a steam boiler so that steam is generated from heat developed in the combustion chamber and the products of direct combustion are conducted through certain controlled passages to the engine cylinder

Railways and Their Accessories.

SPIKE.—C D Walcott Washington D C This spike is one that may be cheaply formed from rolled bars and one that avoids the splitting of the tie and which does not turn or rotate about its longitudinal axis in driving and which withal possesses a much greater holding effect when sunk into the wooden tie than spikes of ordinary cross section

RAILROAD-TIE.—G Whitaker, Temple Texas. This invention is an improvement in railroad ties and fastening and has for an object to provide a simple novel tie that can be used in connection with the ordinary wooden ties, and can be used on any ordinary ballast, will form in itself a track gage and will facilitate the fastening and releasing of the rails as may be desired

AUXILIARY COUPLING HEAD.—P W Hogan Durand Mich The invention is an improvement in heads of the character shown and described in Letters Patent formerly granted to Mr Hogan, the said coupler head having for its purpose to serve as a substitute for a broken coupler head of the "Master Car Builders" type and is connected to engage the draw-bar of the broken coupler at the rear of the head and project a slight distance in advance thereof

AUTOMATIC RAILROAD-SWITCH.—I A Call, Salt Lake City The object here is to provide a switch which may be operated from the train or engine while the same is in motion, or by hand in the usual manner and a switch of the stub rail type which will not be liable to clog from snow, dirt, or other causes, nor from contraction or expansion of the rails at the switch.

TURN-TABLE.—M J Leonard, Long Branch, N J Mr Leonard's invention comprehends a turntable the upper surface of which always remains at the same level, the descent of the weight thus being independent of the upper level of the table—the weight being raised by the forward movement of the locomotive or other piece of rolling stock to be turned.

CAR DOOR.—C. W Leaning Yankton S D This invention has reference to car doors, and more particularly such as are formed of a number of independently movable sections arranged on guideways and adapted to be moved into operative positions away from the door way of the car when not in use

TRACK DEVICE FOR RAILWAY SIGNALS.—M M Kahn Montgomery Ala The aim of this inventor is to produce a device which can be operated by a train passing in either direction, and which is constructed in such a way that it can be readily actuated by a switch point so that a signal near a switch may be controlled from the switch through the device to indicate whether the switch is open or closed

CAR WHEEL.—I P Todd, Middlesboro Ky In the present patent the aim is to provide a wheel especially adapted for mining cars, and provided with a detachable hub which may be removed when worn out and replaced by a new one, or should the wheel proper be injured it may be replaced by a new one, using the old hub

AUTOMATIC SIGNAL AND STOPPING DEVICE FOR RAILROAD-TRAINS.—F J Miller, Cincinnati Ohio This inventor's purpose is to avoid collisions and his device comprehends the electro-magnetic devices in the road bed acting in connection with electro-magnetic devices on engine or car whereby the entry of a train upon a section of track already occupied, will actuate in the on-coming train a signal and will cause automatic devices to be set into action by which the throttle valve is closed and the train is automatically stopped

CAR BRAKE.—H Hoffmann New Rochelle N Y The improvement is on a patent formerly issued to Mr Hoffmann and the present invention is particularly applicable where a brake drum is provided upon which a cable or chain is wrapped the braking force being applied to the brake mechanism through the said chain

RAIL FASTENER.—J Engel, Millersburg Ohio In operation the rail can be fastened or loosened with a sledge and the use of nuts and bolts is avoided The fastener can be applied to a joint as well as any part of a rail between joints and the gage of the track can be changed by removing the metal plate fasteners from one side of the rail and placing them on the opposite side The tie and fastener are thus adapted for use on a curved and straight track.

NUT LOCK.—W R Garner Palestine Texas The device is a combination nut lock and washer and is especially for use on railway rail joints In application the nuts should be loosened sufficiently to permit the driving of the depending washer plates between the nuts and the back plate or angle bar These plates are attached to a top plate and the shoulder springs are also attached at their upper ends to the top plate but all are detached thence to their lower ends Mr Garner has also patented another nut lock in which the nuts will not only be prevented from turning but the plates and angle bars will be held tightly in position on the rail joints to prevent the rails from moving or spreading and the rails going down or dropping in a soft road bed and nuts prevented from rattling or turning back over the bolts and lost motion of nuts and angle bars will be followed up by the spring washers and spring arms

Pertaining to Recreation

DRUM.—A D Converse Winchendon Mass. In this improved construction the head is formed with a hoop section at one end of greater diameter than the body of the drum and the head is also provided with a hoop section which engages with the hoop section of the body and is locked thereto to hold the drum in position

Pertaining to Vehicles.

AUTOMOBILE FIFTH WHEEL.—E. A Oliver, Richland, Mo The objects of this invention are first to provide means by which a cable running from a wheel on the hind axle will be guided onto a wheel on the front axle second to reduce the friction of the cable on the guides third, to provide means by which the front end of the body or springs of the automobile will rest directly over the front axle

VEHICLE WHEEL.—W L. Howard Trenton, N J In a prior application Mr Howard disclosed mechanism for detachably securing tire-carrying rims to wheels, including curved sections moving circumferentially away from each other and radially to grip the rim The mechanism for spreading apart the gripping sections includes a worm wheel carried by a rotatable rod the opposite ends of which are provided with threads of opposite pitch The present invention utilizes substantially the same general features but provides mechanism for spreading the gripping sections and locking them in position.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

The Integrals of Mechanics By Oliver Clarence Lester Professor of Physics in the University of Colorado formerly Instructor of Physics in the Sheffield Scientific School Yale University New York Ginn & Co 1909 8vo, 67 pages with diagrams cloth. Price, 80 cents

The aim of this book is to furnish the conclusion to courses in the integral calculus such as are usually given in colleges and technical schools and at the same time to provide for the beginning of theoretical mechanics, which usually follows the calculus The subject matter is concerned entirely with such applications of the calculus as the calculation of lengths areas, volumes densities centers of mass, moments of inertia and ellipsoids of inertia These subjects are treated in great detail all principles being fully illustrated by examples worked out in the text and by numerous problems set as exercises Since the ground covered is common to both integral calculus and to theoretical mechanics the author hopes in this way to save both time and energy to save time by providing applications of the calculus useful in mechanics to save energy by treating the purely mathematical parts of mechanics entirely apart from the ideas of force and motion This method avoids breaks in the continuity of the mechanics course proper and minimizes the liability of the student to such troublesome confusions as moment of inertia with the moment of a force or center of gravity with the force of gravity Whereas the book is intended strictly as a college textbook and has little interest for those unfamiliar with the calculus it has the additional value of illustrating the practical applications of the latter to those who have commenced its study at college and considered it purely as mental gymnastics

Azimuth By George L Hosmer New York John Wiley & Sons, 1909 16mo 73 pp Price, $1

The purpose of this volume is to present in compact form certain approximate methods of determining the true bearing of a line together with the necessary rules and tables arranged in a simple manner so that they will be useful to the practical surveyor It is a hand book rather than a text book hence many subjects have been wholly omitted which are ordinarily included in books on Practical Astronomy but which are not essential in learning to make the observations described in this book In all of the methods here treated the object sought is to secure sufficient accuracy for the purpose of checking the measured angles of a survey with the least expenditure of time For this reason many approximations have been made and many refinements omitted which simplify the calculations without introducing serious error into the results and although such a treatment would scarcely be proper in a text book the gain in simplicity and convenience would seem to justify its use in a book of this character The methods which are here presented are not new but have all appeared in one form or another in works on Navigation Astronomy and Surveying. Much valuable matter written on this subject is so scattered however that it is difficult to find in one small book all that would be needed by the surveyor in making azimuth observations

Science at Home. Simple Experiments for Young People By P Baron Russell New York R. F Fenno & Co 1909 16mo, 183 pages Price 75 cents

The present volume is an attempt to interest young people in simple physical and chemical experiments. The aim of the book is admirable and the experiments are not beyond the powers of average children

Mission Furniture How to Make It. Part I Chicago Popular Mechanics Company 1909 18mo, 94 pages Price 25 cents.

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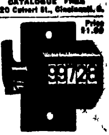

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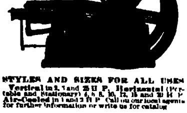

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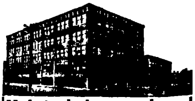

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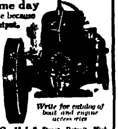

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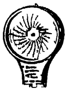

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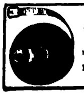

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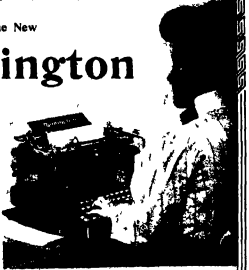

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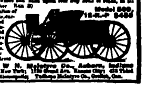

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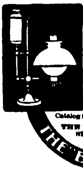

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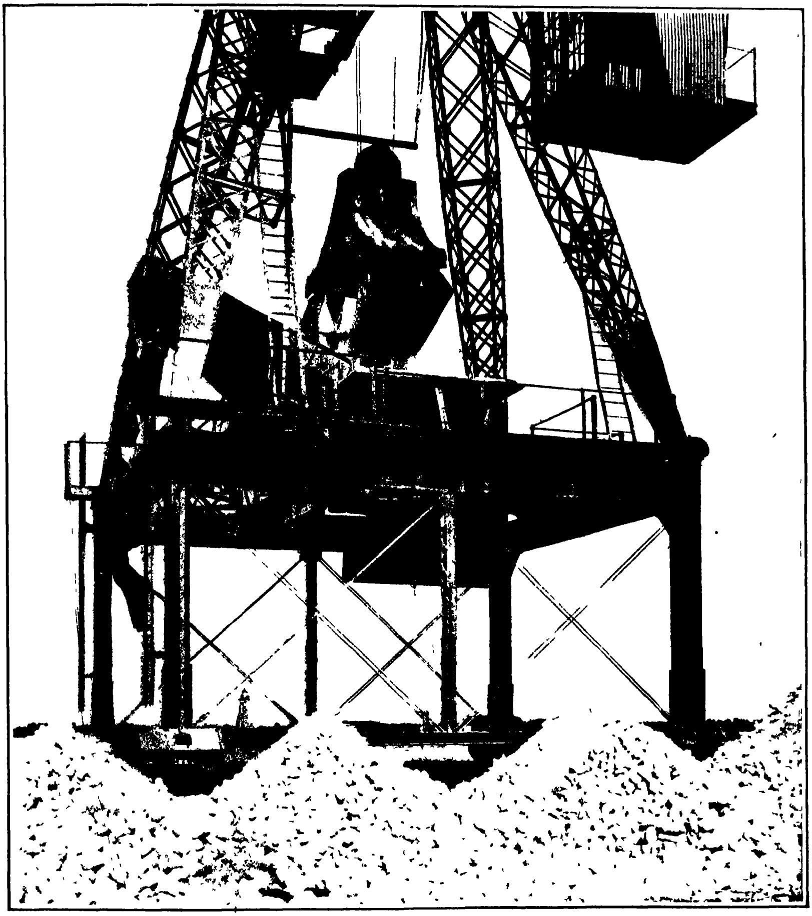

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LESSONS OF THE RHEIMS AVIATION CONTESTS.

The series of aviation contests held last week at Rheims must ever stand out conspicuously in the history of man's age-long attempt to achieve the conquest of the air In speed duration of flight and stability under unfavorable atmospheric conditions, the achievements have shown a wonderful advance in the art of aviation It is safe to say that the most significant feature of the contest—the one which is most prophetic of the future serviceableness of the aeroplane—is the way in which the various aviators dared the elements by bringing out their machines and making some of their best flights when the wind was of a strength which hitherto has been considered prohibitive It was the unfavorable weather conditions rather than the distance which he covered that constituted Latham's spectacular flight of 96 miles at a speed of over 41¼ miles an hour the most remarkable performance since the Wright brothers made that first memorable half mile flight in North Carolina with a power-driven aeroplane

For it cannot be denied that the reluctance of the aviator to bring his machine from the shelter of its shed, except in the lightest airs had shaken the faith of the public in the immediate if not the ultimate practicability of the aeroplane That reckless daring of the Gallic character, which did so much to bring out the inherent high speed of the automobile, seems destined to work a similar result in the even more dangerous field of aeronautics If the cabled accounts of Latham's flight are not over-seasoned with the inevitable enthusiasm of the moment the behavior of his machine during the progress of a storm of wind and rain was indeed phenomenal For an hour ' says the dispatch 'with fluttering wings it fought its way against the storm of rain and wind at an average height of 150 feet mounting higher as the wind rose, until during the worst of the storm it was fully 800 feet above the spectators. But it was reserved for Farman driving a biplane of his own design to establish beyond all question the staying qualities of this type His official record of 111 78 miles in 3 hours 4 minutes 56 seconds and his total flight of 118 miles in 3 hours 15 minutes has carried the long-distance record beyond the expectations even of the most sanguine

At the present writing the results at Rheims seem to have established the superiority of the monoplane in speed and of the biplane in endurance Bleriot with a monoplane holds the record for speed with a time of 7 minutes 47 4/5 seconds for a lap of 6 21 miles, although Curtiss in his beautifully designed and built biplane is a good second with a record of 7 minutes 48 2/5 seconds The compact little biplane of Curtiss, weighing less than half as much as those of his competitors won the international cup over a 12 42 mile course in 15 minutes 50 3/5 seconds Summing up the results it may be said that the brilliant tournament at Rheims has established three facts First that the problem of stability has been solved secondly that an aeroplane motor has been produced which will run until the gasoline tanks are empty, and thirdly, that the problem of alighting without injury to man or machine is yet a long way from solution Regarding this last feature we offer the suggestion that, since the accidents are due largely to the widely extended and delicate wings or planes coming in contact with the ground a great step toward the perfection of the aeroplane will have been achieved, if some method can be devised by which at the moment of alighting the planes can be thrown upward and backward so as to imitate in some degree the folding of the wings when a bird alights That the problem would present great mechanical and constructional difficulties, we admit In a biplane because of the rigid trussing it would seem to be impracticable, but it is conceivable that the problem might be worked out in the monoplane

A SANITARY DRAINAGE CANAL FOR BUFFALO

The Chicago sanitary and ship canal, 22 feet deep, 160 feet wide, and 32 miles in length, which was cut through for the purpose of carrying the sewage of Chicago clear of Lake Michigan and so preserving the purity of Chicago's drinking water, has proved to be a notable success The city of Buffalo is now seeking permission to cut a similar drainage canal to divert its sewage from the Niagara River and thereby get rid of what is recognized to be a great menace to the inhabitants of the Niagara frontier This good work is to be accomplished by the creation of certain artificial channels, into which the effluents from all the sewers can be discharged and it is a fortunate fact that the geographical location of the city makes it possible to do this, by the construction of what is called the Erie and Ontario sanitary canal It is proposed to draw 6 000 cubic feet of water per second from Lake Erie reverse the flow in Buffalo River and Smokes Creek and carry the diverted water to Lake Ontario through an entirely new canal, at a total estimated cost of $30,000 000

The mean elevations shown on the United States topographic maps for Lakes Erie and Ontario are respectively 573 and 246 feet Hence the total difference in level between the two lakes is 327 feet The channel will be so located and constructed as to make the entire head of 327 feet less a small loss in the necessary slope for flow available for the development of power This means that there will be an absolute conservation of the entire natural energy of the water whereas most of the powers now existing along the Niagara River use less than one-half of the total head between the two lakes That portion of the work which lies within the city limits will be built by the city itself The rest of the canal will be built by private capital, and the residents on the Niagara frontier will be given the perpetual right to drain their sewage into the artificial channels thus created Relief will thus be afforded to the people who live along the Niagara River, and are dependent upon that stream for their drinking water

The excavation of the canal will commence at the point where Buffalo River crosses the city line on the east and it will be excavated of sufficient depth and width to stop the crest of the south Buffalo floods by carrying off the waters of the Buffalo Cayuga Casenovia and Smokes creeks The canal will be constructed below all the railroads that enter Buffalo from the east and will pass through the divide at Williamsville through a tunnel four miles in length After emerging from the tunnel it will be continued in open cutting as far as the State barge canal below which it will be carried by a siphon Here the two canals will be connected by a lock through which the traffic of the barge canal can be floated to the freight yard at Gardenville and on to Lake Erie, thus providing a barge canal terminal at Buffalo in addition to that at Tonawanda

If this ambitious scheme were being promoted simply for the development of the 150 000 horse-power for industrial purposes which is the estimated capacity of the canal the chances of securing government consent to the withdrawal of additional water from the Niagara River would be very small indeed, for there is no question that the governments of the United States and Canada and the people of both countries are strongly opposed to any further diminution of the flow at Niagara Falls. The hope of the scheme lies in the fact that it will effectually purify the supply of drinking water, not only of the second largest city of the State, but also of the country and towns adjacent to the Niagara River It is estimated that the construction of the Chicago drainage canal has reduced the high rate of mortality in that city by 51 4 per cent and similar results may be looked for in Buffalo Though the SCIENTIFIC AMERICAN has always strongly opposed any further withdrawal of water from the upper Niagara River we think that the withdrawal of 6 000 cubic feet per second to provide this important city with a pure water supply is a proposition which demands the separate and careful consideration of the Federal government

WHY DO WATCH MAINSPRINGS BREAK?

Your watch has stopped without apparent cause, and you at once attempt to wind it. The crown turns with a new sense of ease, but the operation is endless Then you learn that a fickle mainspring concluded to resign its task and, well—simply broke. Why? Here is a query that may stand in the company of 'Who wrote the letters of Junius?" "Who was the Man with the Iron Mask?" and other unanswered questions of history The best mainsprings have maintained their right to break ever since modern watches were invented and they will do so until some secret of Nature, for which watchmakers are still searching, is revealed Sudden electrical disturbance of the atmosphere extreme changes of temperature, or contact with a cold substance will occasionally result in a broken mainspring Such contingencies are well understood by watchmakers What is not so well understood is why a spring will sometimes snap in twain or in twenty pieces despite the best of care. You may ascribe it to a fit of temper or to the dog days, or give any other reason that is neither logical nor horological The fact and the mystery remain This spring is a piece of tempered steel, usually about twenty inches long, coiled in a barrel between the upper and lower plates of the movement. It is the motive power of the watch It is made in degrees of strengths widths, and thicknesses suitable to the watch. As a mainspring is subjected to varying conditions from that of highest tension when fully wound to that of comparative rest when the watch is run down and as it is constantly undergoing a change in resistance as its coils unfold, it seems to be the only part of the watch, subject to casualties, against which even careful use cannot always provide

It may be well to state just here that all watches of a given make and size do not properly take the same strength of spring A variation in thickness of only two one-thousandths of an inch may be the measure of the difference between the right and the wrong mainspring for your watch Here is the field of the qualified watch repairer To fit a mainspring requires some deftness, but to fit the proper one demands practical experience and judgment. If your watch is worthy of a spring at all, pay a competent watchmaker a proper charge for a good one

But the question, 'Why do watch springs break?' remains unanswered, and the puzzle is still further complicated when we are informed by one of the largest manufacturers of watches in the world that a sudden spell of hot weather is invariably succeeded by a noticeable increase in the number of complaints of broken watch springs At first thought this information is puzzling A sudden drop rather than a sudden rise in temperature would seem to be the natural predisposing cause Cast metals show greater brittleness at low temperatures under all kinds of stress, and steel and iron though at low temperatures they show but little loss of strength under static or under gradually applied stresses show a marked loss under impact or sudden stress

We can understand the breakage of a mainspring when in very hot weather, the watch is taken from a heated trousers or vest pocket and laid suddenly on a cold marble or iron slab, but how shall we explain the sudden breaking of the spring while the watch is running undisturbed in the pocket? Here is a question which we commend to consideration and discussion by our readers.

THE FIRST VOYAGE OF THE "ZEPPELIN III"

The new Zeppelin III" dirigible, after a trial flight of over two hours on August 26th started on a trip from Friedrichshafen to Berlin at 4 A M August 27th The journey was to be made *via* Nuremberg Leipsic, and Bitterfeld the total distance in an air line being about 400 miles After covering 280 miles the airship descended at Nuremberg at 4 45 P M, to effect repairs to one of the motors and also to one of the propellers. The first descent was made at Ostheim shortly before noon for the purpose of taking on water ballast The airship reascended at 2 30, and reached Nuremberg 80 miles distant, in two and a quarter hours, an average of 35 miles an hour From Friedrichshafen to Ostheim it averaged 25 miles an hour Count Zeppelin awaited his new craft at Bitterfeld which point it was expected to reach without a stop. It was his intention to pilot the airship himself from that place to Berlin, where the Emperor was awaiting him

This new airship has two 150-horse-power motors, and is the most powerful air craft thus far produced.

◆

In a new English gas works it was observed that incandescent gas mantles rapidly diminished in brightness and acquired a brown incrustation, which was found to consist of ferric oxide. By examining the gas at various stages of manufacture it was ascertained that the finished product contained the compound carbonyl of iron, formed by the action of the carbon monoxide of the gas upon the iron pipes through which the gas passed at comparatively low temperatures in the later stages of the process. No iron compound was found in the gas discharged by the retorts and the hottest pipes. Carbonyl of iron is not affected by dilute hydrochloric acid When the gas is burned the carbonyl of iron is decomposed into iron and carbon monoxide. A few weeks later, the production of carbonyl of iron was found to have diminished considerably Hence the conclusion was drawn that the interior of the pipes had become coated with tar and naphthalene which protected the iron from the action of carbon monoxide.

[illegible]INEERING.

[illegible] continues to find favor in Europe. [illegible] with a span of 910 feet, is planned [illegible] the Rhine at Koblenz, Germany [illegible] double tracks will be carried by a [illegible] ferry bridge of even greater [illegible] built at Bordeaux, France, over the [illegible] the point of crossing has a width of [illegible]

The [illegible] advancing steadily in size and capacity. [illegible] recently launched the 'Archimedes," whose [illegible] of 800 tons constitutes her the largest [illegible] boat afloat. She is 229 feet 8 inches in [illegible] and is driven by twin-screw engines at a speed of [illegible] knots on the surface, and 10 submerged. Her [illegible] radius is 2,500 miles

In view [illegible] sudden rapid decrease in the freight-car [illegible] the latter part of July and the [illegible], the American Railway Association considers [illegible] within a few weeks there may be a [illegible] In the second week of August there [illegible] 207,178 cars, which represented a decrease [illegible]000 cars during the preceding two weeks.

[illegible] 1908, there were 470 boiler explosions [illegible] States, as compared with 471, 431 and [illegible]ly in 1907 1906, and 1905 The number [illegible] killed by boiler explosions in 1908 was 281, [illegible]300, in 1906, 235, and 383 in 1905 During [illegible]ing period since October 1st, 1867 the [illegible] of boiler explosions was 10 051, in which 15,[illegible] people were injured and 10,884 were killed

One of the most severely used portions of a city street is the [illegible] headers which line the inside edge of car [illegible] are continually exposed to a particularly [illegible]ding effect from the wheels of drays and [illegible] horse-drawn traffic A test of iron-slag [illegible] is being made in the Borough of [illegible]ork where a line of such blocks has been [illegible] the inside of the rails of streets paved with [illegible] blocks They are reported as showing [illegible] qualities.

We have [illegible] referred to the plan by which the United [illegible]ment is now purchasing its coal on the [illegible] heating value, which is ascertained by [illegible]les. The new system of purchase applies to [illegible] buildings in Washington over three hundred [illegible] buildings throughout the United States, the navy yards and arsenals and the Panama Canal Already the government has effected a saving of $200 000 on its annual fuel bill of $10,000 000

Improvements in rolling mill plants make it possible to roll in one section I beams of a weight and size which were beyond the capacity of the mills of the last decade. Formerly when an I beam or other rectangular shape exceeded a certain size it had to be built up of plate and angles riveted together The Bethlehem Steel Works which has been rolling unusually [illegible] shapes, has met with such success that Mr [illegible] is about to expend $5,000,000 in the erection [illegible] furnaces and mills.

At [illegible] those two famous single-screw liners, the "Umbria" and "Etruria' holders of the transatlantic record [illegible] 80 s of the last century, have been withdrawn [illegible] service, not because they are by any means [illegible] out, but because they cannot compete in economy [illegible] twin, triple, and quadruple screw engines [illegible] multiple-expansion and turbine type. These two [illegible] contain the largest single-screw marine engines [illegible] built, they marked the close of what might be [illegible] the single-screw, compound engine period in the [illegible] of transatlantic travel

Work [illegible] actively in progress on the construction of [illegible] mountain railroad across the Andes, this time [illegible] La Paz, Bolivia, to Aricas Chili The railroad, [illegible] is about 33 miles long, reaches an extreme height of 13,000 feet above the sea, and it will serve the important purpose of giving the commerce of Bolivia a port of exit. Sir John Jackson, of London who has contracted to build the road for $15,000,000, on his way home from Chili, by way of New York, made a private inspection of the Panama Canal. He expressed his conviction that the work would be completed in six and possibly in five years from the present time.

The new Pennsylvania terminal station in New York is rapidly approaching completion, and the last piece of stone in the exterior finish of the station was recently put in place The dimensions of this work are unusually large. The exterior walls are nearly half a mile in length, and they contain 490,000 cubic feet of granite. Adding to this 60,000 cubic feet of stone used inside the concourse, we get a total of 550,000 cubic feet of granite, weighing 47,000 tons, which required 1,140 freight cars to transport it from the quarries at Milford, Mass. Into the construction of the building there have also entered 27,000 tons of steel and 15,000,000 bricks, weighing 48,000 tons.

ELECTRICITY.

The British government is about to lay a telephone cable under the English Channel, to be connected with the present land lines at Dover and Calais. It will be equipped with Pupin coils, and is expected to materially improve communication between London and Paris.

The entire machine shop of the International Harvester Company at Sterling, Ill, is to be operated by electricity, for the generation of which turbines are now being installed The substitution of motors at all the individual machines for shafting and belting is expected to reduce the power cost by one-half.

Many of the railways are arranging to employ telephones for train dispatching, the Northern Pacific having already 470 miles of telephone in service and 250 more projected, while the New York Central will have its whole route to Chicago under telephone control when 200 miles of equipment, in addition to the present 250 upon the Michigan Central is complete

A dressmaking establishment in Boston almost entirely operated by electricity has an electric cutter capable of cutting out 250 thicknesses of cloth at once, a button-sewing machine which puts on 7 000 buttons a day, a buttonhole machine making 400 per hour sleeve sewers, tucking machines waist and skirt machines making 1,800 to 3,500 stitches a minute

A new hydro-electric power station has been completed on the Reedy River in South Carolina. It uses the entire flow of the river of 110 cubic feet per second but has a storage reservoir of 1 600 000 cubic feet capacity retained by a masonry dam Three turbines drive direct-connected generators one of 300 and two of 600-kilowatt capacity delivering 60-cycle three-phase alternating current at 2 300 volts pressure

Prof. Gale of the University of Chicago is slowly recovering from his accident last March at the solar observatory at Pasadena, Cal, when he received a shock of 15,000 volts He appears to have suffered less from the actual shock than from burns from a hot rheostat, upon which he was thrown by the shock and lay for a long time unconscious, but his recovery at all is remarkable and cause for congratulation

The valuable work of the United States Forest Service has called attention, among many other matters to the fact that damage to wooden telegraph telephone, and electric light poles by woodpeckers and similar birds may be prevented by creosoting The value of this process for the preservation of wood both from decay and from fungous growth and wood boring insects is well known It has now been found that of poles of identical wood those which have been impregnated with creosote are immune from attack by birds of the woodpecker family in districts where untreated poles are severely injured

The American Mono-rail Company announces that it will commence the construction of a mono-rail road through Pelham Park to City Island early this autumn Engineers of the Public Service Commission who saw the system in operation at the Jamestown Exhibition say that a speed of 135 miles an hour may be expected over parts of the route where right of way has been granted away from highways so that the train head way may be unrestricted If this line meets with the approval of the public application will be made for permission to operate mono-rail express trains on an upper deck over the present elevated railways in New York

The destruction by fire of the long-distance wireless telegraph station at Glace Bay, Nova Scotia, just as it was completed and ready for service is not merely a serious blow to the Marconi Company, but very much to be regretted by all interested in the advancement of radio-telegraphy The towers and aerials were not damaged, fortunately, and the boiler room and manager s house also escaped, but all the valuable machines had been specially made and cannot be duplicated, while quantities of spare parts for them stored in the burnt-out condenser room were ruined The loss amounts to thousands of dollars, apart from the loss of business due to the station having to stand idle until new machines can be sent from Europe.

The latest machine in which electricity has been substituted for steam power is the steam shovel which from its cumbrous parts, rough usage and irregular loads did not seem a likely appliance to be electrically driven. Two 110-ton machines are used in limestone quarrying by the Dolese & Shepard Company of Chicago, in which the hoisting and the digging movement are controlled by separate motors of 200 and 80 horsepower respectively Each motor is separately controlled by an automatic magnetic switch controller, securing the greatest nicety of operation and protecting the motor from overload due to rock encountered while digging. A feed cable is carried on a reel in the cab connecting at a convenient point with fixed conductor and the shovel moves under its own power It has been found very simple and economical in operation, requiring fewer operators than a steam shovel and eliminating the carrying of coal and water

SCIENCE.

The seventy-fifth meeting of the British Association for the Advancement of Science was opened on August 25th in Winnipeg with six hundred delegates present from the United Kingdom, the United States, and Canada. The twelve sections of the Association remained in session for a week One of the principal addresses was delivered by Sir J J Thomson, the president of the Association and is published in the SCIENTIFIC AMERICAN SUPPLEMENT

Capt. Rowland V Webster F R G S is to head an expedition of the Royal Geographic Society to the South Pole He expects to employ an aeroplane or some form of flying machine in making the final dash, and to follow the route taken by the German expedition a few years ago

An effort is to be made to stock the Hudson River as well as other northern rivers of the United States with sturgeon a fish that once swarmed in their waters, but which has since been exterminated The proposal comes from Mr Horace G Knowles formerly American Minister to the Balkan States. Through Mr Knowles s efforts the Roumanian government has promised a carload of sturgeon fry some cans of young sterlet, and smaller food fish to populate our waters. The first consignment of several hundred thousand fry will probably be planted in the Delaware River The native sturgeon have been all but exterminated by wastefulness.

The ancient Romans excelled in making pottery They possessed regular muffle ovens and even a sort of producer gas oven Attempts to produce the beautiful soft gloss peculiar to old Roman pottery have not yet attained complete success. The best result is obtained by Fischer s mechanical process, in which the ware, before it is fired is coated with a paste of clay and pigment and is then polished Fine imitations of ancient pottery are thus produced but the study of defective portions of the genuine *terra sigillata* ware shows that it was made by a different process the gloss having evidently been produced by the application of a superficial glaze without mechanical polishing

Stoklaga has published the results of experiments in inoculating soil with nitrogen fixing bacteria which possess great power of assimilating free nitrogen and are retarded in development by nitrates in the soil The radio-bacteria on the other hand decompose nitrates, and liberate nitrogen which is voraciously consumed by the azotobacteria The results of the experiments show that inoculation with nitrogen fixing bacteria increases the crop and improves its quality, provided that care is taken to supply the carbohydrates potash and phosphoric acid which these bacteria require for their growth and to neutralize the free acids of the soil by applying lime in liberal quantities

Ozone is the best agent for purifying water because it adds nothing except oxygen which assists in aeration An ozonizing plant has recently been installed at Saint Maur near Paris where the water of the Marne River was found to contain many disease germs even after it had passed through sedimentation basins and sand filters The ozone generators are of the Siemens type and are operated by a high tension alternating circuit obtained by transforming the current of a 110-volt alternator which is driven by a 44 horse-power steam engine The total consumption of energy is 1 kilowatt hour for each 1 200 cubic feet of water and more than half of the energy is employed in working the compressing pumps The cost of sterilization is less than 5 cents per thousand cubic feet The temperature of the water is lowered by the operation and not a trace of nitrous oxide chlorine compounds hydrogen dioxide or metallic salts due to corrosion of the apparatus can be detected in the sterilized water Of the ozone absorbed, 73 per cent is consumed immediately in sterilization 7 per cent remains diffused through the water and exerts a subsequent sterilizing effect and 20 per cent escapes into the atmosphere

Walter Wellman's second attempt to sail over the North Pole in a dirigible airship was made on August 15th, and proved a failure The airship met with a mishap about thirty two miles from the starting point. The leather guide rope to which was attached a thousand pounds of provisions and stores, broke away Relieved of this great weight the airship shot up to a great height but the pilot succeeded in bringing it down to earth and in turning it homeward against a strong wind No one was injured The airship has been described in these columns in detail for which reason it is hardly necessary to discuss its construction at length Although the attempt was a failure it must be admitted that while aloft the craft was maneuvered with ease That it was brought to earth after its swift upward rush, and safely landed speaks well for the power of its engines. Mr. Wellman has been working for four years to carry out his idea of reaching the North Pole by an airship His aeronautical idea is the result of two expeditions by sledge and boat into the polar regions.

A NEW SPEED INDICATOR FOR MARINE PROPELLERS

When the steamship Perry G Walker collided with the lock gates at Sault Sainte Marie causing the wreck of two other steamers and doing damage to the locks which required weeks for repair the captain stated under examination that he had signaled to his engineer to go astern but that his signal had somehow been misunderstood and the engines had started full speed ahead Such an accident is conclusive and incontrovertible evidence of the need of a reliable system of indicating the direction and speed of rotation of the propellers of vessels. It is but one instance of a number of marine accidents occurring annually from either the incorrect interpretation of signals given to the engine room from the bridge or the execution of signals given by the bridge which owing to mental stress from impending accident are incorrectly given It is always extremely difficult for a board of inquiry to determine just with whom the error lies

In the above instance it is claimed by the captain that the correct signals were given but instead of the engines being reversed at the critical moment they were sent ahead and before the error was discovered such headway had been gathered by the vessel as to preclude all hope of stopping her within the limited lock space

There is no question of the importance of enabling the captain and pilot to be at all times familiar with the interpretation and execution of signals Errors are thereby immediately discernible and correspondingly corrected before damage is done

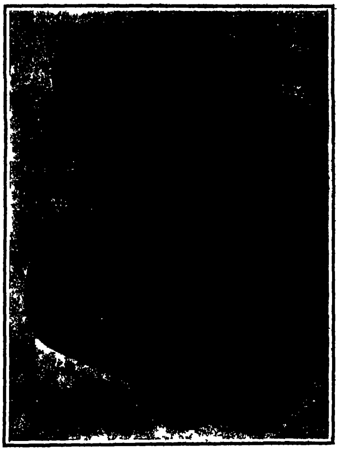
In the absence of a tachometer to show at a glance the rate in revolutions per minute at which the propeller shaft is turning signals are executed by the engineer according to his best judgment For instance the execution of half speed astern may vary eight or ten revolutions per minute and the pilot depending upon a speed-checking effect may be thrown off in his calculations by too slow a rate of turning of the engines

When equipped with a tachometer system however the signals can be obeyed at an exact predetermined propeller shaft speed with corresponding increased accuracy and efficiency of handling the vessel Warships in line or column formation must correctly execute the orders of the flagship setting their speed to conform to the desired headway between ships quickly and accurately Otherwise a collision is probable

The absence of an accurate and dependable tachometer up to the present has made it necessary to arrive at the revolutions per minute by noting the turns successively by the revolution counter for preferably at least a half minute If the speed of the shaft is too high a rough guess must be made as to how much the throttle is to be closed and another counting gone through All this takes time and is on too much of a cut and try system With a tachometer to guide him the man at the throttle has but to operate the throttle until the pointer of the tachometer rests on the desired R P M

Range finding for the accurate sighting of the guns includes the determination of the distance of the object to be fired at angle at which the warship is approaching or receding from the target, and the speed at which the vessel is traveling

The first two factors are quickly and accurately determined by means of the modern range finder in the hands of skilled men, located on the masts or range towers of the warship This is telephoned to the fire control sub-station It then becomes imperative that the rate at which the engines are turning over at that instant be immediately determined in order that the proper instructions may be telephoned at once to the turrets The sooner the discharge of the projectile is effected after the range has been determined the more accurate is the aim and the greater the execution done



A NEW SPEED INDICATOR FOR MARINE PROPELLERS.

In these calculations the effect on ship speed by propeller speed taking into consideration the extent and direction of wind and tide is quickly and accurately calculated

Relation between ship speed and propeller speed is frequently calibrated with due reference to increased fouling of the ship's bottom from marine growth and is immediately available Even when the engine-room forces are endeavoring to maintain an exact prearranged speed of rotation this speed often varies owing to the absence of accurate deadbeat tachometers for indicating at all times the rate of revolution

Aside from the strategic advantages of a tachometer for indicating engine speed of rotation the economic

(Continued on page 167)

POWERFUL HOISTING AND CONVEYING MACHINERY.

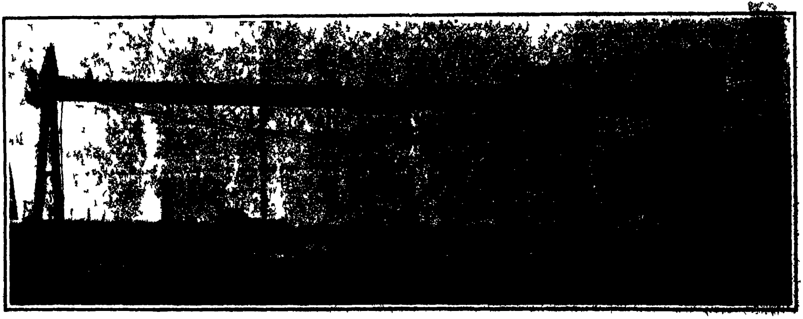
Nowhere in the field of mechanical engineering has American ingenuity in the design of [illegible] plants been shown to more striking [illegible] than [illegible] great hoisting and conveying plants, which are such a prominent factor in our modern constructive and industrial operations. The rapid and cheap raising, removal distribution and deposit of materials in large bulk is one of the most serious problems of the day; and it is the ingenious solution offered by American hoisting and conveying apparatus that has enabled our engineers to dig canals, build embankments handle enormous loads of coal iron ore wheat, and corn with an economy undreamed of in an earlier day We present illustrations of a powerful electric bridge tramway designed and erected by the Brown Hoisting and Machinery Company for the Michigan Alkali Company which is an excellent example of the type of machinery above referred to.

The bridge which is designed to handle the limestone in the stock yard of the company has a span of 250 [illegible] center of pier to center of shear [illegible] depth of 17 feet, and the [illegible] of the structure is 286 feet [illegible] The height from top of rail [illegible] at the shear is 59 feet 2 inches [illegible] the pier 61 feet 9 inches the [illegible] level To the bridge span an[illegible] is attached a runway carrying [illegible] trolley arranged to handle either a two-rope grab bucket or a scraper bucket

The pier consists of two specially designed shear legs mounted on a portal structure arranged to straddle over [illegible] of railway track The two shear legs are joined together at the top by a [illegible], designed to carry the bridge structure By this arrangement a free [illegible] is allowed for the passage of the [illegible] through the pier support The structure of the pier throughout is of medium open-hearth steel The portal or lower portion of the pier consists of two pairs of [illegible] joined together by girders and braces and arranged to carry a bin for the reception and distribution of the limestone The lower portion of the portal is mounted on four two-wheel equalizing trucks These wheels are connected by bevel and spur gears to the driving machinery in the house on the bridge The shear-leg support is of A-frame construction mounted on two-wheel equalizing trucks arranged to run on a single line of rail At the top of the shear is a ball bearing upon which the main bridge is hung The track wheels are connected with the moving gear in the engine by bevel and spur gears

The bridge span consists of two parabolic pin-connected trusses supporting the cross beams from which the track stringers are suspended The bridge span is supported on the pier support by roller bearings, and held in place by a vertical center pin. At the shear support it is hung from a ball and socket connection in such a manner that the bridge may be skewed in either direction from its normal axis, so as to give an angle of one foot crosswise in nine feet lengthwise of the bridge span The moving gear is operated from the main operating mechanism located

(Continued on page 169)



Length over all, [illegible] feet 4½ inches depth of trusses, 17 feet; height of bridge above ground, [illegible] feet [illegible] inches.

Hoisting and conveying machine; capacity [illegible] tons per hour

POWERFUL ELECTRIC HOISTING AND CONVEYING MACHINERY.

Hieroglyphs of the Heavens*

By [illegible]

The [illegible] astronomer who takes delight in contemplating the starry skies, is as familiar with the constellations as he is with the continents and islands of the terrestrial globe He rarely thinks of them however, with regard to the images they are supposed to represent but finds them by means of the quadrangles, triangles, circles, etc by which they are distinguished, and by means of their relative positions Rarely does he realize how long it took for the stars to become systematically classified and the constellations mapped out as they are to-day The skies as we know them owe their arrangement to the Greeks and the Arabians

The first reliable information regarding the Greek sky is obtained from Eudoxus of Cnidus an astronomer who lived about 370 B C His work furnished Aratus, who lived a hundred years later with material for his great astronomical poem The Romans read this in many translations, one of which was by Cicero Instead of Hercules Aratus gives the figure of a kneeling man with outstretched arms called the Kneeling One Above him stand Ophiuchus holding the Serpent, under whose coils Boötes, the Ox-Drover is seen with the brilliant Arcturus under his girdle The other constellations of Aratus are Auriga, the Waggoner, carrying on his left shoulder the goat that nourished Jupiter, and on his wrist a kid, half the body of Pegasus with his wings, the chained Andromeda attacked by the sea monster Cetus (now the Whale); the King Cepheus, Cassiopeia in her chair, the kneeling Bull with the Hyades and the Pleiades the Eagle Dolphin Wolf Centaur the Water Serpent winding across the sky with his head under the Crab and his wreathed body under the Lion and bearing on his body a cup out of which a crow seems to drink and Orion with his dog Sirius here not a star but representing the whole constellation of Canes Major His body is dark says Aratus but a star on his jaw sparkles with more life than any other star

Beneath Orion is the Hare which he is hunting and behind the Dog the Ship Argo sails The Tortoise found by Mercury and converted by him into a lyre here appears with the Lyre on his head and the Swan is described as spreading its pinions in gentle flight and sinking down perpendicularly into the western horizon with its right wing turned toward Cepheus s right hand and its left to the Horse s foot.

The Manger and the Asses are also mentioned and all the signs of the Zodiac.

In great numbers says Aratus and in various courses the stars incessantly move around the motionless skies The axle stands immovable In the midst the earth is suspended in equilibrium while the heavens swing around it The poles bound the axle on both sides These are encircled by the Bears that revolve around back to back separated by the Dragon s manifold coils."

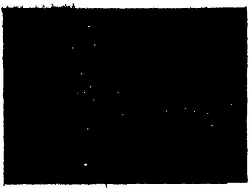
Eratosthenes (about 70 B C) enumerates these constellations and not only tells the mythological stories but indicates the positions and numbers of stars in every figure. He differs from Aratus only in a few particulars the Centaur he calls Chiron gives the Wild Goat and Altar other names introduces Berenice s Hair and speaks of Aquarius s stream of water and the Thyrsus wand of the Centaur

Equuleus the Little Foal of the southern hemisphere seems to have been introduced by Hipparchus (160-125 B C) who compiled a catalogue of a thousand stars with their latitudes and longitudes

Ptolemy (130 150 A D) who extended many of the theories of Hipparchus in his great work to which the Arabs gave the name of Almagest gave forty-eight constellations The figures were the same as the old constellations of Aratus with a few additions The stars however were marked in their proper places and defined as to latitude longitude and magnitude

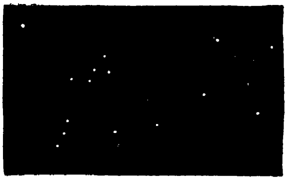
After Ptolemy a long period ensued during which the astronomical charts were unchanged It is to the Arabs in the eighth century that the next advance is due The Caliphs of this period among whom was Haroun al Raschid of Arabian Nights fame were friends to science and gathered around them men of learning such as the famous astronomers Ulug Bekh Fergani El Batan and Abdelrahman Sufi To a great extent they were satisfied with Ptolemy s work to which they gave the name Almagest and although they retained a great many of the Greek star names they added a number derived by tradition from the ancient Arab names Abdelrahman Sufi wrote a detailed and exhaustive account of the Greek constellations carefully following Ptolemy and at the same time he treated of the ancient Arabian heavens

This great mass of uncharted Arabian folk lore is

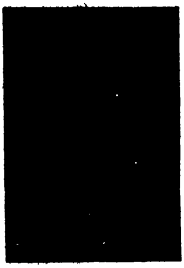


Boötes and the Crown

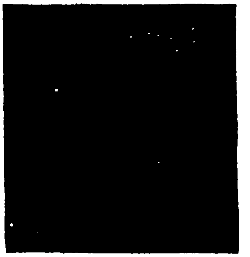
The Great Bear and Cassiopeia



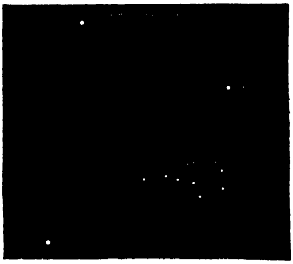
The Great Square of Pegasus



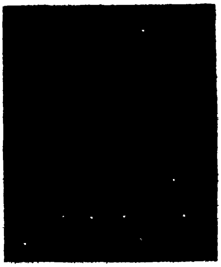
Orion, Sirius, and neighboring stars.



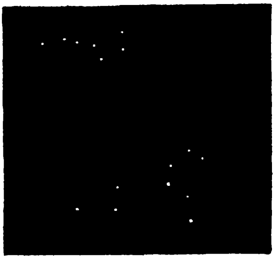
Virgo and the neighboring constellations.



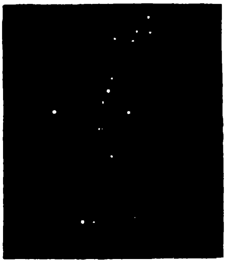
The constellation of Lyra



The Great Bear and Pole Star



The Great Bear and the Lion



Perseus and its neighboring stars

HIEROGLYPHS OF THE HEAVENS

extremely picturesque. The stars in the vicinity of the North Pole are supposed to represent a shepherd, who with his dog is pasturing a herd of sheep. To this group belong also two calves, three goats, four camels and a foal These animals are all in the neighborhood of Cepheus. A single camel (one star in Draco) has strayed away to pasture alone Two jackals and several hyenas are prowling around the herd with wicked intentions. The small stars in the region occupied by Hercules indicate another meadow where another shepherd pastures his flock, and the long row of stars (in Hercules and Serpens) are fences protecting the sheep from the hyenas and jackals. The other side of the meadow is protected by the shepherd's two dogs Many other shepherds with flocks of sheep and camels are scattered through the heavens, and amid these meadows runs a River (the Milky Way), which affords refreshment to various camels, sheep, and ostriches, some of which are in the act of drinking or going to or returning from the River, each represented by stars more or less close to the broad luminous band The oval ring which we know as the Southern Crown is the Ostrich Nest, near which two pairs of Ostriches are supposed to stand Another Ostrich Nest is situated in Eridanus, near which a number of small stars indicate male and female ostriches, young birds eggs, and broken egg shells. Five yelping dogs are marked by five stars in Virgo, a pair of birds by two stars in Sagittarius two frogs by a star in Pisces Australis and one in Cetus, four monkeys by four stars in Ursa Major, and two ravens by two stars in Columba Near Ursa Major and Ursa Minor are a gazelle and its young Three pairs of stars (below the feet of the Great Bear) are the footprints of several gazelles, which, according to the story sprang from that spot when the Lion also in the vicinity lashed the sky with his tail and which is now pursuing these gazelles, some of which have jumped for safety into the great Pond (a group of stars in Ursa Major)

We also find in the Arabian Heavens a Tent (three stars near Auriga), a Traveling Tent (near the Southern Crown), a Pot (a ring of stars in Cepheus and Cygnus), a Beggar's Dish with nicked rim (the broken circle which forms the Northern Crown), a Boat (in the Phœnix), a Manger (in Crater), a Dyed Hand (in Cassiopeia), a Mutilated Hand (in the head of Cetus), and Pearl Necklaces, Brooches, and Crosses are scattered in various parts of the sky The quadrangle of the Great Bear forms the Bier, followed by three mourning women poetically called the 'Daughters of the Bier" These three stars are what we call the tail of the Bear

In many instances as will have been noticed the imaginary figures are not composed of a group of stars, but of a single star Some individual stars, too, are of great importance, the three bright ones that form Orion's belt are the Three Kings, one in Andromeda is the Red Speckled Magpie one in the Great Bear, the Black Horse, belonging, perhaps, to the neighboring Emir and around the North Pole circle the Dancers. Besides these the Arabs have a great many stars with such vague names as the Forgotten, the Touchstone, the Isolated the Dim-eyed, etc

So strong was their objection to the personal element, that when the Greek Zodiac was incorporated by the Arabian astronomers they indicated the names of the objects carried by the characters instead of the characters themselves. Thus Virgo was called the Ears on account of the wheat she held in her hand Sagittarius was not the Archer but the Bow, and Aquarius, not the Water-Bearer, but the Well Bucket.

When the great mixture of Arabian folk lore was combined with the Greek sky many of the star names were retained but occasionally the Greek names were changed, for instance the beautiful red Antares in Scorpio was appropriately called the Scorpion's Heart

The Pleiades.

Castor and Pollux.

HIEROGLYPHS OF THE HEAVENS.

In 1433 Ulug Bekh made at his observatory in Samarkand the most correct catalogue of stars up to that period The famous astronomical tables compiled under Alphonso X of Castile date from 1252, and next in importance was the great catalogue of Tycho Brahé (1546-1601) In this occur two new constellations, Berenice's Hair and Antinous, which Ptolemy mentioned in speaking of the 'informe' of the Lion and the Eagle. Berenice's Hair was erased by Bayer who depicted in his "Uranometrie" (1603) an authority for many years, a Sheaf in its place Subsequently Berenice's Hair was replaced

Two new figures occur in Jakob Bartsch's "Planisphærum' (1624), the Tigris and the Jordan which were repeated for many years on the French maps and globes, and are mentioned in a book by A. Royer (1679) in which a constellation in honor of Louis XIV was introduced This was the Scepter and the Hand of Justice, and was placed immediately over Sagittarius in the Milky Way After the death of the grand monarch, it suddenly disappeared from the globes, its place being taken by the Lizard which originated with Helvetius. In Royer's book the Lily from the old French coat-of-arms occurs in the spot occupied by the Fly A similar liberty was taken by Thomas, in his 'Firmamentum Firmianum" (Augsburg, 1731), where he changed the Northern Crown to "Corona Firmiana,' a device ornamented with two stag-antlers from the German coat-of-arms.

The southern hemisphere, which was uncharted by the ancients, is of far less interest than the northern, partly because the changes have been frequent and unimportant, and partly because the only constellation visible to us is the Dove introduced early in the sixteenth century In the old books it is called Columba Noæ because it is near the ship, represented sometimes at that period as Noah's Ark The regions around the Ship and the North Pole have been subject to the most frequent changes since the seventeenth century For a time the Cock was formed at the expense of the Ship, which however, was soon restored Halley introduced in his 'Catalogus" (London, 1678) the figure of an Oak between the Ship and the Centaur, to represent the tree in which the King of England was hidden for twenty four hours after Cromwell won the battle of Worcester (September 3rd, 1651) Helvetius and Flamsteed accepted this new constellation, but La Caille complained that Charles's Oak was formed out of some of the finest stars in the Ship and ruined this constellation Therefore he left it out of his charts Bode however used it. Halley also introduced another figure—the Heart of Charles the Second—which was finally adopted on all the modern charts and globes. It consists of a single star of the third magnitude on the collar of the Southern Hunting Dog

Vega, the Swan, and the Eagle.

Camelopardus is a young constellation, and was placed in the space between the Pole Star and Auriga about 1624 This is the only figure that remains of the many that were here among which were the Reindeer introduced by Le Monnier when he returned from Lapland, between the Pole Star and Cassiopeia, a Harvest Keeper, between Cepheus, Cassiopeia, and Camelopardus formed by Lalande when the comet of 1774 passed through that unclassified region and named by him for the astronomer Le Messier, who put it on his globe of 1780, and a third figure, formed by Bode as a memorial to King Frederick II called Friedrichs-Ehre consisting of seventy-six stars between Cassiopeia, Cepheus, Andromeda, and Cygnus The figure includes sword, pen, and olive branch laurel wreathed

In 1624 the Fly was made out of the "informe" of the Ram, and the Unicorn was placed between the Great and Little Dogs.

Helvetius is responsible for the Hunting Dogs (Canes Venatice) which run before Boötes; Mount Mænalus, below Boötes, Cerberus in the left outstretched hand of Hercules, the Fox and Goose in the Milky Way, near Sagittarius, the Lizard, near Andromeda, the Sobieski coat of arms, above Sagittarius, the Lynx, between the Great Bear and Hercules; the Little Lion near the Great Lion, and a small Triangle and Sextant. These were published in 1690 after his death and were accepted.

Early in the seventeenth [illegible] was made to substitute Biblical names [illegible] for those of classic myth and legend. [illegible], for example, published in 1627 a star [illegible], popes, martyrs, and persons from [illegible] New Testaments were figured in rich co[illegible] in the style of the illuminated manuscr[illegible] Middle Ages. Christ was represented as [illegible] and the planets revolving around him wer[illegible] instead of Saturn; Moses, Jupiter; [illegible] John the Baptist, Venus, Elijah, Mercu[illegible] the Virgin Mary was substituted for the moo[illegible] with Goliath's head was placed on the ma[illegible] of Perseus with the head of Medusa, Samso[illegible] the jawbone of an ass, instead of Hercules[illegible] on which Christ rode to Jerusalem instead o[illegible]; Noah's Ark for the Ship Argo; the Cross [illegible] Swan; the dog of Tobias instead of the Gre[illegible] Dog, etc. The signs of the Zodiac were name[illegible] twelve Apostles the Ram became St. [illegible] St. Andrew, the Twins, St. John, [illegible] John the Evangelist, the Lion, St. Tho[illegible] Virgin, St. James the Less, the Scales, [illegible] the Scorpion, St. Bartholomew, the [illegible] Matthew; the Goat, St Simon, Aqua[illegible], and the Fishes, St. Mathias.

In the latter part of the same [illegible] attempt was made by Weigel, w[illegible] the coats of arms of various famili[illegible] and other devices in his "Cœlum H[illegible], 1688), where we find the Brand[illegible] in place of the Eagle, the Elepha[illegible] in place of the Great Bear, a Cardi[illegible] of the Scorpion, the double-headed [illegible] Eagle for Orion, etc. Flamsteed's "Sky Atlas," corrected by Bode (Berlin, 1782), gives two new constellations the Brandenburg Scepter near Eri[illegible] the Poniatowski Bull, named in honor of th[illegible], near the Eagle including the Hyad[illegible] of all the constellations is the Cat, in[illegible] between the Cup and the Ship in [illegible] century After Napoleon's death so[illegible] to place him in the heavens in [illegible] but his figure appears in no map of t[illegible]

The accompanying illustrations [illegible] Sir Robert Ball's "Story of the He[illegible]

* * *

The Current Suppl[illegible]

The opening article of the curre[illegible], No. 1757, deals with the railway-car fe[illegible] Germany and Sweden, and describes [illegible] the vessel called the "Drottning Victo[illegible] Mr. A. [illegible]'s excellent article on imitation arms [illegible] concluded In 1911 Rome is to be the [illegible] celebration of the fiftieth anniversary of the pro[illegible] of the Italian kingdom For that reason [illegible] article on Old and New Rome seems peculiarly a[illegible]. The paper read by Prof Harold A. Wilson [illegible] the Royal Institution on the Electrical Properties of Flames is summarised Mr Percy Collins contributes an article on Ants and Bees as Pets. Mr Snowden B. Redfield prophesies that in a few years a [illegible] who desires to call another over the telepho[illegible] not only make all the electrical connections [illegible], but will deposit his money in an automatic [illegible] talk as long as he likes, and then have his ch[illegible] automatically handed back to him This p[illegible] he bases upon the [illegible] performances [illegible] automatic telepho[illegible] central, which is de[illegible] at length Mr A[illegible] Watson contributes [illegible] entertaining article [illegible] Old Conjurers' [illegible] and Utterances. [illegible] of the most brillia[illegible] read before th[illegible] Association for [illegible] Advancement of Sc[illegible] at its Winnipeg meeti[illegible] was that of Sir J J. Th[illegible]. In the current Su[illegible] will be found an abstract of that paper, entitled "Studies of Electricity and Matter"

* * *

Swarms of bees are sometimes compelled to take refuge in very remarkable shelters. A peculiar and instructive instance was observed by the writer in the spring of 1908 The swarm flew over a large vineyard which contained few buildings. One of these buildings was constructed of hollow concrete blocks. The swarm flew directly toward a small hole in one of the blocks and disappeared in the interior No doubt the swarm had rested on a tree or shrub on the preceding day and had sent out scouts to seek a home. The scouts found the little hole leading into the great cavity of the concrete block, and reported their discovery to their comrades. This case furnishes indisputable proof that swarming bees really send out scouts, as they are believed to do, for the little hole could not have been discovered in the rapid and lofty flight of the swarm.

THE AVIATION MEETING AT RHEIMS

The first real aviation meeting held anywhere in the world took place last week near the city of Rheims, France. The Betheny plain, which is several miles in length and a mile or more in width, was the scene of a triumph of aeroplanes such as even the most enthusiastic aeronauts did not believe possible. Not only were all records broken, but new ones were set up which are far in advance of the supposed state of the art at the present time

Altogether there were thirty-eight aeroplanes entered for the various contests and races, for which $40,000 in cash prizes were offered The machines which made flights were divided about equally between the monoplane and the biplane types, although the latter type was rather more in favor Of the machines of this type, five were Wright biplanes, five biplanes of the Voisin cellular type with a tail, and three of the Farman type with a tail but without vertical partitions between the main planes. The Curtiss biplane represented America.

The monoplane type of flying machine was represented by three Antoinette machines, two Bleriot, and three Pelteries.

The course over which all the contests took place was a rectangular one, the total distance around it being 10 kilometers (6.21 miles) The judges' and timekeepers' stand was in the middle of one of the short sides, just opposite the grand stand. A row of aeroplane sheds was placed at one end of the grand stand.

The first day of the meeting, Sunday, August 22nd, was given up to trials of the machines entered in the International Cup Race for the Bennett trophy On account of the seventeen entries, elimination trials were required in order to select three contestants to represent France in the race

As there had been rain the preceding day and also early Sunday morning, and as the wind still continued to blow at the rate of about 12 miles an hour, the weather conditions were not propitious for the first flights. Soon after 10 A. M Monsieur Maurice Guffroy attempted to get off the ground with his red winged "R.E.P" (Pelterie) monoplane, but on account of the sodden condition of the earth, he was unable to rise in the air M Paul Tissandier was the next to make an attempt. He had a Wright biplane, and as this starts from a rail, he had a distinct advantage over M Guffroy It was with considerable difficulty, however, that everything was put in readiness about the starting apparatus in the fifteen minutes allowed for making a start. Then, too he had trouble with his motor Finally, however, he got away just as the time was up The machine rose and made a two-minute flight, during which all the skill of the aviator was required to keep it right side up At length it was caught by a stronger gust than usual, which caused it to make a dive. M Tissandier stopped the engine and glided to earth Thus was eliminated the second entrant for the International Cup Race.

M. Hubert Latham was the next one to attempt a flight with his powerful Antoinette monoplane He rose in the air readily but when once aloft the strong wind gusts caused his machine to pitch and roll in an alarming manner After covering about a kilometer he quickly descended, landing safely In a second trial later on, M Latham qualified by making two rounds of the course (20 kilometers or 12.4 miles) in 18 minutes and 38 seconds. No sooner had M Latham descended than M. Louis Bleriot rose in the air in his No 22 monoplane fitted with a 45-horse-power Anzani motor But even this skillful aviator had difficulty in keeping his monoplane on an even keel in the wind which was blowing. He covered the course once, and was making his second round when a sudden gust drove his machine earthward and damaged the tail in alighting. He had covered sufficient distance to be appointed one of France's representatives in the International Race.

Capt. Ferber, who flies under the pseudonym of De Rue, made a short flight with his Voisin biplane He came very near running into a barricade opposite the grand stand. M. Lefebvre, with a Wright machine, succeeded in starting during a calm moment. He made a round of the course in 8 minutes and 8 1-5 seconds, and although he was obliged to descend during the second round, and after covering but 16 kilometers (10 miles) on account of the wind, he was appointed as the third representative in the cup race. M. Tissandier afterward made two rounds in 19 minutes and 26 seconds, and was appointed as a reserve pilot. M. Latham, on the "Antoinette II.," made two rounds in 19 minutes and 44 1-5 seconds. M. Paulhan made two rounds with his Voisin biplane in 21 minutes and 4-5 second, and M. Sommer in 38 32. Thus, although six reserve pilots were allowed, only three—Tissandier, Paulhan, and Sommer—were appointed.

As the weather cleared in the afternoon, and the wind ceased entirely, ideal conditions prevailed toward the end of the day, with the result that almost all the [illegible] brought out their machines and made flights [illegible] evening. At 6 o'clock no less than five aeroplanes were flying simultaneously around the course, and the sight was one never to be forgotten M. Lefebvre on his Wright machine performed the most daring feats, besides describing circles and figure eights, he would rush at the grand stand, and then quickly turn to the left and avoid it. M Paul Tissandier and Count de Lambert made excellent exhibition flights upon their Wright aeroplanes The latter at one time flew past M Bunau Varilla on his Voisin biplane, going below him and thus reversing Mr Curtiss's maneuver of the day before, when he passed above M Latham when flying at right angles to him

The results of the first day's attempt to cover one and three circuits of the course (10 and 30 kilometers, or 6 21 and 18.63 miles) in the speed tests, were as follows

	3 Rounds.	1 Round
Tissandier (Wright biplane)	28 59 1/5	9 26 1/5
Count de Lambert (Wright biplane)	29 03	9 33 2/5
Lefebvre (Wright biplane)	29 02 1/5	8 58 1/5
Latham (Antoinette monoplane)		9 47 4/5
Paulhan (Voisin biplane)		10 50
Bunau-Varilla (Voisin biplane)		13 30 1/5
Sommer (Farman biplane)		11 24 2/5
Cockburn (Farman biplane)		11 44

The following day, Monday, Mr Glenn H Curtiss covered one round of the course in 8 minutes and 35 2/5 seconds. He succeeded in lowering this to 8 minutes and 11 3/5 seconds on Wednesday although he was not able to equal M Bleriot's record of 8 minutes and 4 2/5 seconds (46 15 miles an hour), made Tuesday by this aviator with a new monoplane fitted with an 80-horse-power motor The third day of the meeting was notable on account of a visit paid by the French president M Fallieres, who inspected all the machines and showed great interest The first flight this day was made by Bunau Varilla who flew in a breeze of 15 miles an hour, which caused his Voisin biplane to rock dangerously He made one circuit of the course Next M Paulhan made a flight, rising first to a height of about 100 feet and afterward to between 300 and 500 feet. On the back stretch he raced a train for some distance, overtaking and passing it. Despite the strong wind, which caused the machine to pitch and lurch he made the first round in 12 minutes and 13 seconds. After completing three rounds of the course he made a sudden descent and a wide curve, but righted his machine when near the ground, and passed the grand stand on a level keel, making a couple of wide circles in front of it before he alighted As an exhibition of daring his flight in the 15-mile wind at such a great height stands unprecedented The time of his three rounds was 38 minutes and 12 2/5 seconds M Paulhan's performance indicated that he might yet do greater things, and it was only the next day that he succeeded in breaking all endurance records. On Wednesday, August 25th, he remained in the air 2 hours 43 minutes, 24 4/5 seconds. He covered a distance of 134 kilometers (83¼ miles) After several other aviators had made short flights, M Paulhan started about 4 P M in a wind of about 6 miles an hour, and circled the course continuously, notwithstanding that the wind blew at times as high as 24 miles an hour While the speed of the machine was only about 30 miles an hour, it was remarkable for the ease with which it flew in the wind and for the steady running of the motor This motor is the Gnome revolving-cylinder 50-horse-power engine, consisting of seven cylinders which spin around a fixed crank. The propeller is attached to the cylinders, which revolve in a vertical plane, the motor being placed in the rear of the lower plane

M Paulhan had already made several lengthy and excellent flights with his biplane, but that on the 25th ultimo is by far the longest, exceeding Wilbur Wright's 2-hour and 20-minute record by 23 minutes The first round of the course was made in 12 minutes and 16 seconds. During the sixth round the wind increased to such an extent that M. Paulhan was blown inside the course, and in order to turn the pole at one corner he was obliged to describe a complete circle After alighting, when his gasoline gave out at 7 30, he had the tank refilled, and then flew from the point where he came to earth across to the grand stand He received an ovation from the spectators. M Paulhan's flight was for the Grand Prix de la Champagne, the prize for which is $10,000 to the winner

Another aviator to make his appearance on Wednesday was M Rougier who had a Voisin biplane. He made the first flight of the day, but his motor gave out, and he came to earth shortly after crossing the starting line After two unsuccessful attempts, M Latham flew once around the course at a great height with his "Antoinette XIII" at the same time that M Paulhan was flying. He only succeeded in making one round, owing to motor troubles and the wind at a high elevation appeared to bother him as much as it did Paulhan, who was flying lower down M Henri Fournier, in a Voisin machine, was another novice to attempt a flight. After getting three-quarters around the course, he was dashed to the ground by the strong wind, and escaped with a broken nose although his machine was demolished M Latham also made a round at a great height with his No. 29 Antoinette monoplane. M Lefebvre was the only Wright pilot to attempt a flight. He soon came to earth, owing to the breaking of the gasoline feed pipe M Delagrange made a short flight on a small Bleriot monoplane, and M Bunau Varilla made a good flight on his Voisin biplane M Latham's best performance this day was three rounds of the course Between 6 30 and 7 P M eight or nine machines were quickly brought out and attempts were made to better the 10 kilometer speed record The Curtiss biplane was the last to start, which it did when no less than five aeroplanes were traveling around the course The aviator took the first turn rather wide He was obliged to fly above one machine, and he ran out of his course somewhat in order to avoid a collision with M Sommer on his Farman biplane He reduced his time to 8 minutes and 11 3/5 seconds in this flight. Short flights were made by M Legagneux on Capt. Ferber's biplane, M Rougier and Bunau Varilla on their Voisin biplanes, M Sommer on a Farman biplane and M Delagrange on the Bleriot monoplane M Bunau-Varilla rose to a height of more than 300 feet

The record for speed and distance was made on August 26th by M Latham with his No 29 Antoinette monoplane The weather conditions were favorable at the start, but during the course of the flight M Latham encountered heavy wind and a rain storm He nevertheless kept the machine flying until the fuel gave out. He succeeded in making over fifteen rounds of the course in 2 hours 18 minutes and 9 3/5 seconds. The total distance covered was 154 375 kilometers (95 88 miles) The average speed was therefore 41 62 miles per hour The fastest round was made in 8 minutes and 20 3/5 seconds, at an average speed of 44 65 miles an hour This record surpassed that made the day before by M Paulhan, since the machine flew a considerably greater distance in less time, while it also demonstrated its stability in a wind of about 24 miles an hour and its capability of traveling through rain The flight was a complete vindication of the Antoinette motor which, it will be remembered failed Latham twice when he attempted to cross the English Channel This motor is of the V-type, having eight water-cooled cylinders It is one of the lightest motors ever constructed per horse-power Besides making this record flight in the P M Latham flew 70 kilometers (43 5 miles) in the A M with the "Antoinette XIII" Count de Lambert flew 116 kilometers (72 miles) late in the P M also so that the long flights on Thursday totaled over 212 miles M Bleriot met with an accident on Thursday In order to avoid alighting upon some dragoons who were traveling across the field on horseback he steered his machine into a fence breaking the propeller and damaging the monoplane considerably He was making a flight with M Delagrange as passenger when the accident occurred M Rougier also alighted upon some spectators, but fortunately they were not seriously injured

Latham's distance record of Thursday was a record of only a day for on Friday, August 27th Henri Farman surpassed it decidedly with his modified Voisin type biplane now known as the Farman machine The sixth day of the meeting was the last one in which the Prix de la Champagne could be competed for, and everyone took it for granted that Latham's record of 95 miles in 2 18 would remain unbeaten About 4 30 P M Latham brought out the "Antoinette XIII" monoplane and started on another long flight Some ten minutes later MM Farman and Sommer started out quite unexpectedly upon Farman biplanes and a real race at once began. At the end of Latham's second round, he passed high above Sommer and Farman, who were flying close to the ground at about the same level and only 50 feet apart, Sommer leading The two biplanes made the last turn of the course only a second apart, and then Farman passed Sommer in front of the grand stand while the latter's machine dropped and touched the ground just as it crossed the line Sommer accordingly circled around the timer's box and crossed the line once more according to the rules, which maneuver placed him far in the rear Both biplanes flew at an average height of from 6 to 12 feet only while Latham maintained an elevation of from 250 to 300 feet His machine was considerably faster than the other two and he lapped both of them several times Latham covered 50 kilometers (31 05 miles) in 44 23 against Farman's 51 21 Eighty and 100 kilometers (49 71 and 62.14 miles) were covered by Latham in 1 11 20 1/5 and 1 29 20 2/5 respectively but finally after making 110 kilometers (68 35 miles) in 1 38 5 1/5, his fuel gave out and the monoplane glided to earth After Latham ceased flying Farman kept steadily on Sommer stopped after making three rounds because of motor trouble He afterward started again but too late to make a record before the closing of the lists at 7 30 Shortly before 5 P M M Tissandier started on his No 4 Wright machine and made 11 circuits in 1 46 52 2/5 At about the same time, Bunau Varilla made several circuits on his Voisin biplane, and Delagrange and Bleriot came out

(Concluded on page 171)

MEASURING A RIVER'S FLOW

BY A. MAYS BALL

The increasing attention which is being given to the conservation of natural resources particularly to water power and the irrigation projects of the United States Reclamation Service renders timely some description of the manner in which the water supply is

Gaging the flow of a mountain stream with hand instrument

measured and recorded. Through the kindness of Mr. H. C. Rizer, Chief Clerk of the United States Geological Survey at Washington, the writer has been given facilities for a study of the system generally adopted, which is as follows:

The quantity of water flowing in a stream is expressed in various terms according as it represents the drainage from a watershed of given area, the rate of continuous flow as for power purposes, or simply volume, and it may be as well to commence with a definition of these terms.

Second foot, an abbreviation for one cubic foot per second, is the quantity of water flowing in a stream one foot wide, one foot deep, at a rate of one foot per second. It is generally used as a fundamental unit from which others are computed.

In connection with pumping and a city's water supply the water is generally measured in gallons per minute.

The miner's inch is the quantity of water that passes through an orifice one inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West and is defined by statute in each State in which it is used.

The average number of cubic feet of water flowing per second from each square mile of area drained on the assumption that the run-off is distributed uniformly both as regards time and area is given as second feet per square mile.

Run off in inches is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run off with rainfall which is usually expressed in depth in inches.

An acre foot is equivalent to 43 560 cubic feet and is the quantity required to cover an acre to the depth of one foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot. One second foot flowing for twenty-four hours will deliver 86 400 cubic feet or approximately two acre-feet.

Gaging stations are located upon streams as far as possible at points above and below which the channel is straight, where there are no cross currents or backwaters and where the bed of the stream is smooth and its banks high. Their equipment consists of fixed gages graduated to show the vertical fluctuations of the water surface and permanent bench marks indicating the points of measurement up and down stream. When the channel conditions are satisfactory bridges are used as from them observations may more readily be made and the cost of equipment is small.

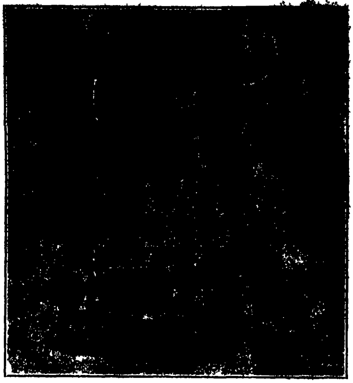
Current velocity is measured sometimes by floats and sometimes by means of the meters illustrated herewith. In measuring by floats, of which there are several kinds, the simplest being a corked bottle weighted at the bottom and carrying a flag at the top, little affected by wind, observation is made of the time taken by the float to pass over a selected run of the stream 50 to 200 feet long. A number of velocity determinations are so made at different points across the stream and the mean velocity of the whole section estimated.

The discharge is the product of that mean and the mean sectional area of the run, which is determined by measurements and soundings of the two ends of the run and at intermediate points.

When meters are used they are held stationary in the current at a number of points across the width

A meter calibrating station: the meters are drawn through still water at a known speed, and the revolutions they make recorded.

of the stream and at different depths and the velocities recorded are averaged as before. A typical meter much used in the government service is shown in the illustrations designed by Mr. W. G. Price. Its submerged portion consists of a small wheel carrying five conical buckets similar to that of the [illegible] meter; these are rotated by their [illegible] resistance to the current at their large [illegible] small ends, the axis of the wheel carrying [illegible]tric by means of which electrical contacts [illegible]



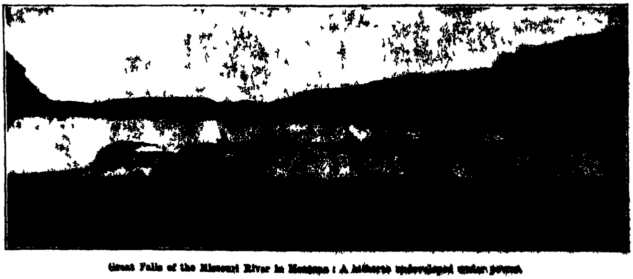
On the left a small Price electric meter, sounds received at the earpiece being transmitted by current from the small battery shown; on the right a Price acoustic meter.

and broken in a suitably protected water-tight compartment. The number of revolutions made by the wheel are thus electrically recorded by the current of a battery operating the clockwork of the indicator dials. Two of the small portable meters are also shown; in one the revolutions are recorded by the striking of a small hammer on a diaphragm, the sound being conveyed by a tube to the ear of the observer who counts the revolutions, and in the other an electric current from the small battery shown operates a buzzer when the contact is made and broken as has been described for the larger machine.

In each case the meter is supported above a pointed weight, provided with fins which keep it pointing straight upstream both in the vertical and horizontal plane.

To insure the coincidence of readings by different meters each individual instrument has to be separately "rated" to determine the exact number of revolutions it will make in a current of a certain speed. This is done by drawing the meter through a measured space of still water at a number of different speeds and noting the number of revolutions made, from which a rating table is prepared giving the velocity per second corresponding to any number of revolutions. Current-meter measurements may be made by an observer on a bridge, suspended from a cable, in a boat or wading, and gaging stations are classified in accordance with the method used. A wading station is shown in one of our illustrations.

The velocities indicated by the meters at different points in the stream are averaged by a variety of methods known as "multiple point," "vertical integration," etc. In the various multiple point methods the stream is divided theoretically into strips in the direction of its flow, [illegible]



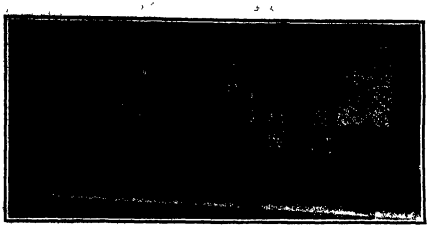
Great Falls of the Missouri River in Montana: A hitherto undeveloped water power.

MEASURING A RIVER'S FLOW

GERMAN MUSEUM OF MASTERPIECES OF SCIENCE AND INDUSTRY.

BY OUR BERLIN CORRESPONDENT.

Both England and France have long been in possession of a museum illustrating the evolution of science and industry and the mutual influences between engineering, scientific research work, and commerce and trade. The Conservatoire des Arts et Métiers of Paris (founded at the end of the eighteenth century), besides representing the significance of technical achievements in their relation to the factors above mentioned, is intended to propagate technical knowledge by the aid of popular lectures. The collections of the Kensington Museum (established toward the middle of the nineteenth century) on the other hand afford a comprehensive idea of the gigantic strides made by England in the field of mechanical engineering, without there being any more intimate connection between this part of the museum and its mathematical and scientific departments.


Apparatus used in Korn's picture telegraphy.

Successive stages in the evolution of the plow

The German Museum of Masterpieces of Science and Industry, which was inaugurated a short time ago, is intended to become a national German institution of a similar kind, a special point, however, being made of the mutual influences of science and engineering. Apart from retrospective exhibits, the very latest achievements in the field of technical and scientific investigations were to be represented. Besides serving as a Pantheon to those men whose thought and work have been operative in fashioning modern civilization, this museum was thus to become a source of historical knowledge to the scientist, and a place to which both engineers and laymen could refer for fertile ideas and models.

Evolution of the automobile.

As the Bavarian Academy of Sciences as far back as twenty years ago had made plans for extending its mathematical and physical collections on strictly historical lines, many useful instruments and apparatus of historical importance were already at the disposal of the founders of the new museum. The latter was inaugurated a few years ago (on June 28th, 1903) in provisional headquarters, the state having placed at its disposal the rooms of the old National Museum in Maximilianstrasse. As, however, these in the following years proved inadequate, an extension was granted by the Department of War, which at the beginning of 1906 authorized some collections of the museum to be installed in the Isar Barracks. The foundation stone of the definite building was finally laid a few months ago by the German Emperor. The museum comprises

1. Collection of scientific instruments and apparatus as well as of remarkable technical products (both originals and models), which collections are well classified and provided with necessary information for the benefit of the visiting public

2 An archive containing important documents both scientific and technical.

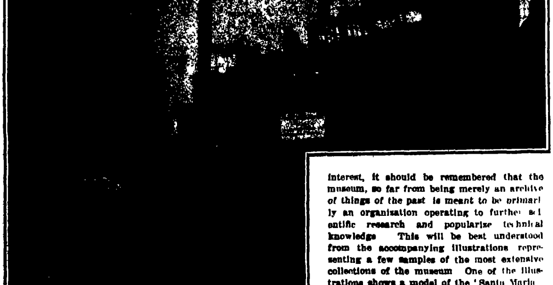
3. A technical and scientific library containing manuscripts, diagrams, pamphlets and books

In order to preserve the memory of prominent workers in the field of engineering science portraits and biographies of those Germans whose labor has been especially noteworthy in furthering the evolution of industry will likewise be incorporated with the museum

In carrying out the task laid before the museum viz., to illustrate the evolution of any fundamental ideas and the influence of such ideas on the various economical factors, as well as to represent the ideal success of acquired knowledge and the importance of past experience the most varied methods and means had to be resorted to In fact, many fields which apparently are strictly separated from each other, had to be classified and combined together in order to afford an adequate picture of civilization as an offspring of science and engineering

The historical aims of the museum are mainly realized by original machines and apparatus in addition to records of the very first experiments in a given direction, and the earliest sketches and designs These collections in order to illustrate the achievements of science and industry in a really comprehensive manner necessarily had to be international

The central library above referred to and which is intended for serving the scientific purposes of the museum contains both ancient and modern works, pamphlets periodical publications, etc on subjects of engineering mathematics and science While furthering historical investigation this library is intended to make accessible to both specialists and lay people the very latest scientific and industrial achievements An archive of maps and diagrams of unsurpassed dimensions is connected with the library and will allow both the engineer and workman to obtain useful information on subjects otherwise inaccessible While the collection of documents and manuscripts is of mainly historical interest, it should be remembered that the museum, so far from being merely an archive *of things of the past is meant to be primarily* an organization operating to further scientific research and popularize technical knowledge This will be best understood from the accompanying illustrations representing a few samples of the most extensive collections of the museum One of the illustrations shows a model of the 'Santa Maria in which Columbus discovered America The interior of the alchemistic laboratory forms part of the exhibit and will be found espe


Example of evolution on the Rigi railroad.

GERMAN MUSEUM OF MASTERPIECES OF SCIENCE AND INDUSTRY cially instructive as compared with the examples of chemical laboratories in the eighteenth, nineteenth, and twentieth centuries. While on one hand a most striking progress from the primitive apparatus of alchemists to the improved instruments of modern chemists will be noted it is interesting to observe that certain apparatus still retain their original traditional form in which they have been used by the predecessors of present-day chemists. The evolution of plows is figured from the most primitive implement, viz., roughly shaped trees drawn first by men and afterward by oxen, to the present-day steam plows, passing through many stages which had to be traversed in various ages and centuries. Another feature in evolution pertains to the development of automobiles, from the first motor-car constructed by Daimler in 1885 to the most improved modern types. In the same hall will be found a similar retrospective exhibition, relating to the various stages in the evolution of cycles. The strides made in a special branch of railway engineering viz., the construction of mountain railway locomotives are graphically rendered. Side by side with the latest type of locomotive used on the Rigi railway is a model of the earliest type used on the same railway line, the latter having been constructed in 1871.

In the exhibit representing the achievements in the field of electricity is shown the outfit used in the Korn picture telegraphy, of which a description was given some time ago in the columns of this journal. To the left in the illustration will be noted the sending apparatus with an electric lamp and the cylinder on which the photographic film is wound up, while the receiving apparatus is shown at the right. Diagrammatic views and descriptions in addition to some samples of telephotographs further facilitate the understanding of this apparatus the importance of which will be fully gaged only after its introduction into general practice.

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Black Diamonds.

BY GEORGE E WALSH

The term "black diamonds" is sometimes jokingly applied to ordinary coal which we burn in our furnaces, but the real black diamonds of commerce are among the most unique mineral products of the world and they serve a purpose in the industrial world that makes them of great value. The black diamonds are pure carbon and yet in no outward appearance resemble the diamonds which we are accustomed to wear as ornaments. They are slightly harder than the crystal or gem diamonds, and in fact about the hardest substance known.

Black diamonds or carbons are among the greatest curiosities of the mineral kingdom. They are without crystalline form and are found in irregular pieces ranging in size from half a karat up to three four and five hundred karats. They are dark gray black, or brownish in color and opaque. The real diamond of the jewelry trade is also pure carbon but translucent and crystalline in form. Two objects so alike in composition could not be found so opposite in appearance as these two forms of carbon.

Another peculiar thing about the black diamonds is that they are found only in one locality in the world. They come from a very small section in Brazil not more than 225 miles square in area. Outside of this limited territory no pure black diamonds have ever been found. In the Brazilian black diamond fields the natives dive in the river beds for them and recover them from the gravel and washings of the rivers.

What peculiar freak of nature caused the deposition of the black diamonds in this section of the world and nowhere else is one of the mysteries which science has failed to explain. None of them has been found in the great Kimberly diamond regions, where the crystal form of diamonds have for so long been mined, and likewise no fine specimens of the gem diamond have been found in the Brazilian black-diamond fields.

The whole origin of the black diamonds is therefore a scientific enigma. Naturally the question is raised "Of what use is a black diamond?" No one would care to wear one of these diamonds which resembles a piece of coal more than a real diamond, and so far no one has popularized the black gems as the black pearl has been. Nevertheless the black diamonds serve a most important and useful function in the industrial world.

This pure black carbon is not only harder than the real diamond but tougher and not so brittle as the gem. Consequently it is of great value for many mechanical purposes, and particularly for boring with diamond drills. In diamond drilling, the tips of the drills are studded with carbon or black diamonds, and when the bores are deep, the pressure is so great that the gem diamonds would be crushed in the process. But the carbon resists this continued pressure, and slowly eats down into the rocks.

In diamond drill work, the carbon is set in circular pieces of soft steel or iron, called bits, and these bits are attached to tubing. Armed with these black-diamond teeth, the drills push their way down under severe pressure to a depth of five and six thousand feet, cutting through the hardest kind of rock. Some black diamonds are much harder than others, and there is no way to determine by the color the difference in the degree of toughness.

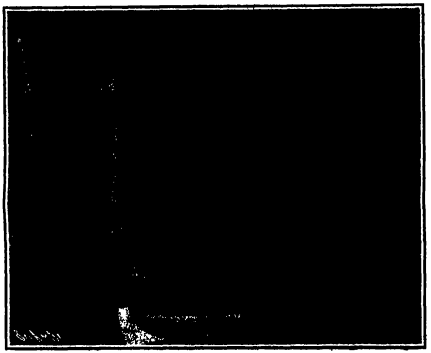
Black diamonds or pure carbon are not by any means cheap, and the owners of the mines in Brazil where they are gathered are making a good thing out of their monopoly. In the last thirty years the prices of black diamonds have advanced from $5 to nearly $85 a karat, and the tendency is still upward. The arming of a drill with diamond points is thus a rather expensive matter. Usually a set of eight stones are placed in the head of a single drill. If each diamond weighs only three and a half karats, the total cost at $85 per karat would be about $2,380 for a single bit.

Great as this expense is, however, it pays, for the black diamonds are so tough that they last a long time, and they achieve results which could not be obtained in any other way. There is no known substance that can take the place of carbon in drills in boring for gold, silver copper, and other mineral deposits. Before the black diamonds of Brazil were discovered, it was impossible to make deep borings.

When the carbon was first introduced in our industries it was used in diamond saws for cutting stones, marble and similar substances. Then the price advanced so that the carbon was found too costly for such use and bort was substituted for stone cutting. Bort is really an imperfect crystal or gem diamond, but it is too brittle for use in drills. Consequently, bort has taken the place of black diamonds for stone cutting and the latter have been restricted almost entirely to diamond-drilling purposes.

The average size of black diamonds used in the drills ranges from two to five karats, but the larger specimens give much better results. They cost more, but they last longer. Consequently, there is a greater demand for the larger pieces of pure carbon, and the price is sometimes run up to premium figures for unusual specimens.

The fear that the supply of black diamonds may some day give out and paralyze the diamond-drilling industry has stimulated prospectors to systematic search for new deposits, but so far they have not been successful. On the other hand, scientists have been making a close study of the chemical conditions which have produced the black diamonds, but their manufacture is apparently about as difficult as the making of the gem diamonds. It is possible under certain conditions to make either but not in sizes sufficient to be of any commercial value. Nature in some peculiar way has made these rare products, and then thrown the secret of the process away. If any man can ever unlock or find that secret, he may cause a panic in the diamond trade.



The "Santa Maria," which carried Columbus to a new world

GERMAN MUSEUM OF MASTERPIECES OF SCIENCE AND INDUSTRY.

The Real Value of Steam [illegible]

In general, it may be said that a furnace [illegible] signed to burn almost any kind of coal with good efficiency, and that the real value of a coal depends very largely upon the number of British thermal [illegible] which it contains. So states Mr. D. T. Randall, engineer in charge of fuel engineering department of the Arthur D. Little, Inc., laboratory of engineering chemistry, Boston, Mass., in a recent paper. He points out that tests which have been made at the government fuel-testing plant seem to indicate that the most important thing to be considered in a coal is its heating value. Following this, the size of the coal may be considered next in importance, and when the moisture, volatile matter and ash are widely different they must also be considered. The results of more than 400 boiler tests at the government testing plant show that the average drop in efficiency for a range of [illegible] 14,000 B T U and 10,000 B. T U is only [illegible] per cent. This difference is due to the [illegible] influence of the size of the coal and the moisture, volatile matter, and ash in the coal. It will be seen from these figures that the probable influence of any of these constituents is not as great for hand fired furnaces as it is often thought to be. With certain boiler equipments in which a considerable overload is necessary at times, the effects of these constituents may be much more important, owing to the reduction in capacity which may be obtained, and it is for this reason that when coal is selected for a given plant it is important that the coal supplied should not vary greatly from time to time, otherwise, the fireman may have serious difficulty in maintaining the capacity required, and in burning coal with good efficiency.

With a furnace which is well designed, there should be a close correspondence between the heating value of the coal and the water evaporated. Small variations in moisture volatile matter, and ash should make little if any difference in the efficiencies obtained.

The size of the coal may influence the results to a serious extent. Small sizes of anthracite coal pack together closely and strong drafts are required to burn them. This results in holes in the fire and a leakage of air in the boiler settings. The loss is often estimated to be at least 10 per cent. This is also true of many of the bituminous coals. Other coals which coke readily forming a loose bed of fuel, do not show much loss, due to the presence of fine coal, except such as is so small as to be carried off from the grate by the draft. With any character of coal there may be a loss of fine coal, due to sifting through the grates. That this loss may be large is well known. The carbon in the ash is an important item in determining the losses in a boiler room. In many plants care on the part of the firemen has reduced this loss to the equivalent of 2 and 3 per cent of the fuel fired. Occasionally, owners of power plants have purchased for testing purposes a coal of higher grade than they usually furnish for the boiler furnaces. The results obtained have often been disappointing, and without further investigation they have declared that the plan of purchasing coal on the basis of its heating value is at fault, and that corresponding results cannot be obtained from the higher grade coals. On the other hand, it has happened that others have tried coals of lower heating value than the coal regularly burned in their plants, and they often find a greater drop in the evaporation than they expected. This has led many people to believe that there is a great difference in the value of coals for only slight variations in the composition.

Boiler tests are a rather crude method of comparing coals, especially if the fireman is not accustomed to burning the coal to be tested.

A chemical laboratory test is conducted under conditions which may readily be duplicated, and the results are therefore more reliable than boiler tests.

The averages of a number of boiler tests on each coal on which the combustion is fairly good in all cases should show results which agree quite closely with the chemical results on the coals, provided they are of the same general character. If they vary in composition, a slight reduction in efficiency may be expected for the coals high in moisture, volatile matter, and ash.

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The Mexican Central plant at Aguascalientes for preserving railroad sleepers with oil, which was started some years ago as an experimental plant to develop and perfect the Ebano oil process, is now treating about a carload, of 3,500 sleepers, daily. Each sleeper takes up about three gallons of oil.

Handy Man's Workshop

HOW TO MAKE CONCRETE POTTERY —VI.

BY RALPH C DAVISON

(Concluded from the issue of August 14th.)

In the previous articles nothing much has been said in detail in regard to the numerous and various materials which can be used in making concrete, such as the different kinds of stones, pebbles, etc Nor has anything been said about the quantity of each ingredient necessary to make a fixed amount of finished material.

Concrete is made by mixing together with water various proportions of Portland cement, sand and stone. The sand and stone which go to make part of the mixture are commonly known as aggregates. It is by the careful selection of these aggregates that we are able to produce numerous pleasing and artistic results.

In many cases, if the proper aggregates are used in the right proportion, natural stones such as limestone, granite of all colors, brownstone, and French Caen stone, etc., can be so closely simulated that it takes an expert to tell it from the real material

The ordinary concrete or cement surface as usually seen is most uninteresting in appearance As a general thing, it is smooth and lifeless and of a dull gray color The same general appearance as just described for ordinary concrete will prevail in almost any concrete surface, no matter what the aggregate used unless the surface is treated so as to expose or bring out the aggregates used If, however the surfaces of the concrete in which selected aggregates have been used are property treated, a marked difference between these surfaces and those obtained with ordinary mixtures will be noted By varying the kind size, and proportions of the aggregate used surface finishes of practically any desired color and texture can be obtained, the possibilities being limited only by the number of different kinds of aggregates available and the combinations of the same

In small work, that is, where the thickness of the finished product is to be ½ inch or less never use any aggregate exceeding ⅛ inch in size especially so if the mixture is to be made thin enough to pour In larger work having a thickness of 1 inch or more, aggregates up to ¾ of an inch can be used with good results

Some interesting textures for pottery work can be obtained from the following mixtures

A mixture composed of 1 part white marble chips not exceeding ¼ inch in size, and 1 part of trap rock or other dark stone of the same size mixed with 1 part of Portland cement and 1 part of marble dust will produce a surface similar in appearance to a light granite This mixture should be allowed to set for twelve hours after pouring, then the molds should be carefully removed, as the concrete is still green, and the surface of the concrete should be lightly brushed with a stiff brush

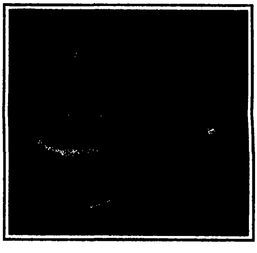
As the concrete is not thoroughly set or hardened yet, this operation will remove the surface cement and thus expose the aggregates of marble and trap rock After having performed the above operation allow the piece to harden a few days, and then treat the surface with a solution composed of 1 part of commercial muriatic or hydrochloric acid to 3 parts of water Dash this solution onto the face of the concrete surface with a brush, and allow it to remain for at least fifteen minutes. Then thoroughly scrub it off with a good stiff brush and plenty of clean water This operation will remove all of the surplus cement, and will leave a good clean surface full of life and sparkle. Instead of using white marble chips and granite, as above, one can vary the results by using white marble chips and crushed-up red brick, or various colored marbles crushed to the proper size can be used, and than by treating the surfaces as explained the colors in the various aggregates will be exposed, thus producing some very interesting surfaces

A good light-colored surface somewhat simulating limestone can be procured by using 1 part Portland cement to 2 or 3 parts of white marble dust. After this has become thoroughly hard, treat it with acid as described above. The acid will eat off any surface cement, and thus the marble dust will be exposed, producing a pleasing sparkle throughout the entire surface. To simulate white marble, use 1 part white Portland cement to 2 parts of marble dust, and treat surface with acid as described.

By incorporating in the above mixture a small amount of yellow ocher a pleasing buff that will be given to the mass, which will then very closely resemble French Caen stone To simulate red granite, use red granite chips or screenings. These can be procured at almost any stone yard where they cut granite. The pieces to use should range in size from ¼ inch down to dust. If the pieces available are too large, they can be crushed up with a hammer The proportions of the mixture should be 1 part of Portland cement to 2 parts of the granite After having set for twelve hours, brush the surface out and treat it with acid as already explained and the surface thus obtained will very closely resemble the real red granite. From the above details the reader will have grasped the possibilities to be obtained by the selection of aggregates, and now by using a little ingenuity can without further instruction experiment along original lines, which will be found most fascinating work.

In regard to the amount of the various ingredients to use for a fixed amount of finished material the uninitiated often think, and naturally so, that if an amount of finished material equal in bulk to three glassfuls is required, all that is necessary to do if it be a 1 to 2 mixture, is to take one glassful of cement and two glassfuls of sand, and then by mixing these together they will still have an amount of material that will fill three glasses. This is not so The particles of cement are ground so fine that the cement is practically one dense mass, but the particles of sand are coarser, and between each of the particles appears a space or cavity These cavities are called voids, and it is in these voids that the larger portion of the cement finds its place when the mass is mixed The majority of sands used in concrete work contain from 25 per cent to 40 per cent of voids. If we take the larger figure for an example, then in two glassfuls of sand we will have 80 per cent of one glassful of voids. As we only have one glassful of cement to add to the two glassfuls of sand, and as the cement fills the 80 per cent of voids in the sand it is plain that we have but 20 per cent left upon which we can figure for bulk Therefore, instead of having three glassfuls of material, as one might naturally think we will only have two glassfuls and 20 per cent of one glassful over, or two and one fifth glassfuls of finished material The percentage of voids varies largely in different grades of sands. The finer the particles of which the sand is made up, the smaller the percentage of voids It is always best to use sand in which the particles are not uniform in size, or in other words, use what is commonly termed a well-graded sand By this is meant a sand in which the particles vary in size say from 1/32 inch or less up to 1/16 inch or a trifle more The heavier the work, the coarser the sand that can be used. Be sure that the sand used is clean By clean sand is meant sand that is free from loam or clay One can readily detect dirty sand by placing same in the palm of the hand and slightly wetting it Then if by rubbing it around the hand becomes discolored, there is more or less dirt in the sand A little dirt will not do much harm, but it is always well to have it perfectly clean It is often found necessary to wash the dirt out of sand by means of water This can be done by placing the sand in a pail of water and agitating it, thus making the dirt rise to the top To thoroughly wash the sand keep running the water into the pail and agitating the sand until the water discharged is practically clear

When using a stone aggregate in the mixture the spaces or voids between the particles of stone are filled by the cement and sand in the mixture, as were the voids in the sand filled by the cement. As in sand the larger the particles of stone used the greater the percentage of voids in it will be Therefore a greater amount of sand and cement will be required to fill them.



APPARATUS FOR MAKING ARTIFICIAL LILAC PERFUME.

By a little experimenting along these lines, one will become experienced enough to judge fairly closely the amount of each ingredient to use in mixing up any amount of finished material needed It is always well to mix a trifle more material than is needed rather than not enough For when one once starts pouring a cast, he should continue to pour until the mold is full If not, a mark is very apt to show in the finished cast where pouring was left off and started again Never try to use any material that has been mixed and let stand for more than half an hour For in this time the concrete will have commenced to get what is called its initial set. If the mass is now disturbed and worked up again the product produced will never have the same strength as one made with freshly-mixed material In mixing always mix the cement and sand together thoroughly before adding the water One can judge by the color of the mass fairly well as to whether the mixing is complete If the color is uniform throughout it is a pretty good sign that the aggregates are well distributed through the mass. When making a mixture containing cement, sand and stone always mix the cement and sand dry first and then add the stone which has previously been well soaked in water In this way one is assured of having each stone coated with the cement and sand for as soon as the damp stone comes in contact with the dry cement and sand they adhere to it and cover the stone completely thus a compact matrix of cement and sand is formed between each and every particle of stone which binds them securely together into a dense and compact mass.

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HOME-MADE CHEMICAL PERFUME

BY GUSTAVE MICHAUD COSTA RICA STATE COLLEGE

Early in the nineteenth century chemists generally thought it impossible to make organic compounds out of the elements found in them Synthesis they believed to be practicable only in the case of minerals. Woehler with his remarkable synthesis of urea shook that belief at least as much as the Curies recently shook the common belief of chemists in the integrity of the atom Other organic syntheses followed that of urea, and some of them as that of the alizarin dye, were made in conditions so favorable that it became unprofitable to grow the plants from which the chemical had hitherto been extracted Thousands of acres have thus been so far given back to the cultivation of food stuffs and one may confidently expect a time in which most if not all of our drugs dyes and even food will be made through synthesis Agriculture then will be a thing of the past Factories will make for us sugar starch fats, proteids that is to say bread eggs milk fruits besides some new foods which may prove as superior to the old ones as antipyrin and pyramidon have proved superior to the natural alkaloids formerly used in similar circumstances

The most recent and greatest advance in the organic synthesis of industrial products can be observed to-day probably in the perfume industry The fragrance of heliotrope hyacinth, pink rose violet hawthorn lilac, musk wintergreen vanilla cinnamon bitter almonds, and that of many fruits are now produced with chemicals which frequently have but a repugnant smell or no smell at all Most of these syntheses require complicated apparatus as well as considerable chemical skill but in one case at least that of terpinol, an essence now sold sometimes under the name of lilac sometimes under that of lily of the valley the operations are simple enough and the synthesis is but an enjoyable experiment easily performed at home or in the class room

Besides the vessels found in every kitchen the only needed apparatus are a round bottom flask (capacity about one pint) a rubber stopper with one hole and two glass tubes united with a piece of rubber tubing The preparation may be divided into two operations, i e the transformation of common oil of turpentine into terpin and the transformation of terpin into terpinol The first operation requires much time and no care whatever The second operation is made in less than a quarter of an hour

One-half of a quart bottle is filled with oil of turpentine Three-fourths of a pint of alcohol at about 80 per cent is mixed with it and one-fourth of a pint of nitric acid is added to the mixture, which is left to itself for several days until crystals are formed These are collected and dried with some blotting paper They are pure terpin To get the full amount formed in such circumstances one should wait over three months but for experimental purposes such a delay is of course unnecessary Moreover should the experimenter wish to prepare the perfume at once he may get the ready made terpin at the drug store as it is prescribed by physicians for a kind of lung trouble

To transform odorless terpin into fragrant terpinol terpin must be heated with water containing a small amount of sulphuric acid The round bottom flask is half filled with water Two or three large spoonfuls of terpin are thrown into it and about as much sulphuric acid is slowly poured into the flask There is no danger in pouring sulphuric acid into water but water should never be poured into sulphuric acid, as the heat thus suddenly generated may cause some of the caustic liquid to be thrown out of the bottle

An alcohol lamp is now lighted directly under the flask If a gas stove be used a piece of wire gauze should be interposed between flame and flask As soon as the liquid in the flask begins to boil the glass tube is plunged into the water in a tumbler There the steam and the terpinol carried along with it noisily condense A delightful scent fills the room To keep the tumbler cool place it in a bowl of water The operation is over when the liquid in the tumbler has become nearly hot in spite of the water in which the glass is immersed A layer of liquid terpinol will then be found to float over the water The fragrance which is extremely strong while the essence is warm becomes much more agreeable after it has cooled Some odoriferous plants such as marjoram contain terpinol in their leaves but the extraction of the essence from such sources is always much more expensive than its synthesis with oil of turpentine

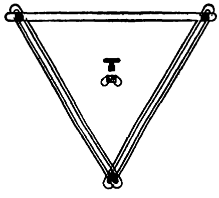
◆

PAPER HANGER'S ADJUSTABLE TEMPLET

BY I G BAYLEY

This handy tool will be found useful and will save considerable time in cutting wall paper up the rake of a stairway or where any roof slants allowing the paper hanger to cut a number of lengths of paper on the paste board at once where at present it is only customary to cut one at a time

The tool can be made of wood and satisfaction obtained although a better tool can be made from saw steel Each blade is about three feet in length two of them being furnished with slots running almost the full length Three thumbscrews detailed on a larger scale will be necessary to hold the frame together after the proper adjustment is obtained The paper should be hung in position on the wall and one side of the tool held along the perpendicular edge of the paper while one of the other sides of the tool is adjusted to suit the angle of the stairway or slanting roof when the screws are tightened up and the frame permanently set


PAPER HANGER'S ADJUSTABLE TEMPLET

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HOW TO MAKE A SIMPLE DRY BATTERY

BY E BEN F WORTS

Often the experimenter is in need of a good dry battery of a certain size or shape for some particular work where the ordinary standard sized cell is either too large or not of the right shape for the same work An inexpensive dry cell that will produce results and can be made by anybody capable of handling a soldering iron has long been the desire of every experimenter The cell as described herein has been used for many purposes and with marvelous results by the writer and has been used in other shapes where economy in space was desired such for instance as in wireless telegraphy

To make a cell of the standard size a strip of zinc of medium thickness 8¼ inches long and 6 inches wide is necessary The zinc is rolled into a cylinder 6 inches long and 8 inches in circumference thus leaving a quarter of an inch which is to be tightly soldered A zinc cap is next soldered on one end of the cylinder Any solder showing on the inside is to be well shellaced Do not shellac any zinc surface as that will interfere with the action of the battery Line the inside of the cylinder with a thin layer of blotting paper For the positive pole of the battery the carbon from a wornout cell is the best if procurable but if not a bundle of arc light carbons with the copper surface well filed off is the next best The chemicals for producing the action that generates the electricity are ¼ pound of sal ammoniac ¼ pound of chloride of zinc (paste form) ¼ pound oxide of zinc and ¼ pound plaster of Paris These salts should be thoroughly mixed with a mortar and packed tightly in the cylinder about the carbon, which is a half inch from the bottom of the cell. This paste will fill the cylinder to within half an inch of the top, the rest being filled with paraffine A copper terminal soldered to the zinc and a heavy copper wire scraped clean and bound about the protruding end of the carbon form the negative and positive connections for the cell

This cell can be easily formed in various other shapes to suit the experimenter's fancy The cell herein described if constructed according to specifications will produce very satisfactory results especially in ignition work or for wireless It will register about 1 2/5 volts and between 10 and 15 amperes

◆

HOME-GROWN CALABASH GOURDS

BY CHARLES A MIDNAN

The Department of Agriculture through its office of foreign plant introduction has brought to the notice of the smokers of the country one of the most useful articles of their trade This is the curious calabash gourd a plant indigenous to South Africa, and from which the highest quality of pipe bowls can be made

PIPES MADE FROM CALABASH GOURDS

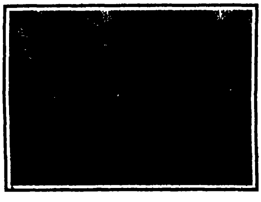
The plant is now being introduced into the United States for the purpose of pipe making and it has been found by experiments to thrive perfectly in our climate The perfect success with which the gourd can be grown in almost any part of the country warrants the belief that it will prove a good investment to import a large amount of seed from South Africa

A curious feature of the calabash gourd pipe is its great resemblance to a certain capacious bowled meerschaum popular in Germany It is said that a Boer farmer first utilized the gourd as a pipe and that the English shortly afterward recognized its merits and the use to which the plant could be adapted

From the educated smoker's point of view the calabash pipe not only yields a very sweet and cool smoke but it colors beautifully far surpassing in this respect the finest meerschaum Besides taking on a high polish its life is about as long as that of a French brierwood pipe The usual lining is of plaster of Paris usually known by the trade as pipe meerschaum

The present market price of these calabash pipes is rather high owing to the fact that there are but few grown in this country and also to the fact that these gourds are never of the same shape and size necessitating the making of the mountings by hand

The writer was given a few seeds for testing and his success was all that could be desired The plant was of very hardy growth and the fruit set very easily As there was only one plant each flower had to be pollenized The plant was grown on a trellis about five feet high but as the fruit began to get very heavy it had to be tied to the wire In growing the plant for pipes it seems to demand a very hot and dry soil with rain at the right season to bring the gourds to perfection The curved stem end of the calabash forms a light and appropriate shape for the pipe The majority of the gourds take their own shape but for special shapes they must be tied.

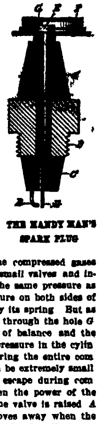

THE GOURDS ARE TIED TO THE TRELLIS TO GIVE THEM THE PROPER SHAPE

Any man who has a small space in his yard can grow enough pipe gourds in a season to last him for several years.

THE HANDY MAN'S SPARK PLUG

BY S W [illegible]

The spark plug shown here is equally well adapted for high or low tension ignition It may be made by a handy workman out of an old mica plug by taking out the steel wire down the center and putting in its place a piece of brass tubing, 3/16 of an inch outside diameter and ⅛ of an inch inside diameter *A* and *B* are the terminals forming the spark gap *C* is the mica, and *D* the threaded body of the plug The upper end of the terminal *A* is riveted to a small valve which is pressed down by a weak spring and thereby closes the upper end of the tube as shown in the sketch A valve chamber is screwed on the upper end of the tube, thus holding the mica together The valve operates in the chamber being fastened thereon by the screw *F* The valve and its seat should be ground flat and then the terminal *A* should be riveted to it There is a small hole *E* in the cover of the air chamber The cover should be fastened to the chamber with a screw or other simple means so that it may easily be detached for the purpose of cleaning the valve In use the terminal *A* vibrates with a noise like the trembler of a coil and in this way strikes the terminal *B* During the compression stroke the compressed gases travel up the central tube lift the small valves and instantly fill the valve chamber to the same pressure as the cylinder With the same pressure on both sides of the valve it will be forced down by its spring But as the gases in the chamber *C* escape through the hole *G* the pressures will be thrown out of balance and the valve will again be raised by the pressure in the cylinder This action will continue during the entire compression stroke The hole *G* should be extremely small and the amount of gas that will escape during compression will not perceptibly lessen the power of the engine It will be clear that as the valve is raised *A* approaches *B* and also that *A* moves away when the valve is closed because the fulcrum is virtually at the screw *F*



THE HANDY MAN'S SPARK PLUG

As *A* keeps striking *B* while it vibrates the low tension contact or touch spark may be used with this plug This plug gives many contacts and therefore many sparks instead of the single contact given by the usual hammer and anvil This plug is far simpler than the hammer and anvil system and besides it does not leak and lose compression like the latter does when worn It will work with high tension ignition with a trembler coil As the terminal vibrates it keeps itself clean and an excess of oil or soot will not affect it like an ordinary plug If used for high tension ignition the period of vibration should not be the same as that of the coil trembler or an odd spark will be missed owing to *A* being sometimes in contact with *B* when the high tension current is in the act of flowing The terminal *A* may be made to vibrate as rapidly or slowly as desired by strengthening or weakening the valve spring

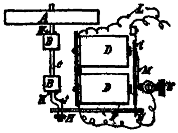
◆

HOW TO MAKE A SIMPLE ELECTRIC ENGINE

BY ROBERT M SHOLEMAN

A simple electric engine may be made as follows Take an ordinary electric bell and remove the gong The striker arm should be cut off about ⅜ inch from the armature leaving the butt *G* A strip of brass 1/16 inch thick and ¼ inch wide of suitable length is bored at both ends one end to fit the butt *G* and the other end to fit the crank *J* of the shaft *C* The shaft is made of ⅛ inch diameter brass or steel Care should be taken to make the stroke of the crank *J* the same as that of the armature

The balance wheel *A* is fastened to the shaft *C* Any wheel of suitable size and weight can be used In the model made by the writer a valve wheel 2 inches in diameter was used



A SIMPLE ELECTRIC ENGINE

The bearings *B* can be made of strip brass—in the model screw eyes were used *K K* are wire rings soldered to the shaft *C* to keep it in place *H* is a wire ring soldered to the crank to keep the strip *F* in place

When the screw *E* is properly adjusted and the terminals *L* are connected to a battery the engine will run at a high rate of speed.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

MILLINERY DEVICE.—J Forpes, New York, N. Y. This invention relates to a device by which one may determine the effect of any particular style of hat without having the actual hat at hand. A relatively large card or screen is provided having a display opening for the head, and a pictorial representation of a hat about the opening, a portion of which is adjustable to and from the screen in order that the effect of the hat may be obtained.

SKIRT-LIFTING DEVICE. — M Becher, Wilmington, Del The object here is to provide a device arranged for attachment to the waist of a woman, to allow her to raise the skirt evenly all around and to support it in this position without requiring the use of the hand, and with a view to prevent the skirt from being soiled when walking in rainy weather, and to allow her to use both hands freely for carrying an umbrella, or when entering or leaving cars and vehicles.

BOOT AND SHOE HANGER.—C R Rosuck, San Bernardino, Cal. This device is adapted for use in suspending or supporting boots, shoes, and other foot wear having a sole or heel crease, the same being in the nature of a spring clamp adapted to embrace the heel portion of the article and thus hold it by friction in any position in such manner as not to obstruct the view of the same appreciably

Electrical Devices.

MACHINE TELEGRAPH — G C. Read, Davenport Station Toronto, Canada Mr Read's invention refers to machine telegraphs, his more particular object being to provide a receiver system including mechanism whereby currents sent over an electric line and made up of dots and dashes, are caused to operate the keys and analogous parts of a typewriter, so as to print the letters corresponding to the telegraphic characters.

ELECTRIC GENERATOR —E. F White, Spokane Wash This invention refers to electric generators of the portable manually-operated type, the more particular purpose being to provide an improved form of such generator especially suitable for blasting and having a high degree of efficiency with great mechanical strength.

ELECTROTYPE.—A Van Winkle, Newark, N J The electrotype is for use in galvanizing iron or steel in such a manner that a very heavy and smooth deposit is obtained. For this purpose use is made of a solution containing fluosilicate of zinc in combination with certain salts, and a small quantity of gelatin or other organic substance that improves the deposit.

Of Interest to Farmers.

CULTIVATOR.—D J Ellis, Parlier Cal The invention relates to cultivators, and has for its object to provide a cultivator with teeth which may be adjusted as to depth and which may also be rotated in the teeth bar so that the cutting edge may be turned to any desired angle relatively to the said bar

PLANTER.—J H McCoy Aberdeen S. D The aim in this improvement is to provide economic check row devices of novel construction and accurate in operation and that will avoid the use of ropes, wires, or equivalent guides, and wherein the working mechanism includes means for effectually laying off or marking the rows to be planted

PIG-FORCEPS. -W Robertson Vail Iowa This invention is an improvement in pig forceps. In operation it will be found that the forceps may be easily inserted and engaged with the presenting portion of the pig, and when once engaged will retain a firm grasp thereon. The different sized pairs of blades also provide for the use of the same instrument on large and small animals.

EGG-CARTON -- R. M Odell, Hoisington Kan. One object of the inventor is to provide a device by which eggs may be shipped without danger of breakage, in separate cells which are so joined together as to form a single package designed to be placed in a case, and when so placed to form a rectilinear body which will act as a brace for the case itself

POTATO-PLANTER.—G W Nation Alliance, Neb. This potato planter attachment is for use in connection with the agricultural implement shown and described in a co-pending application filed by Mr. Nation In operation a roller engages an arm thus swinging the latter out of a chute and dropping a potato cut into the furrow As soon as the roller passes the end of the arm a spring immediately returns it into a pocket to engage another cut. The disks are provided with arms, which loosen the ground and cover the potato cuts deposited in the furrow.

STRAW-RACK FOR GRAIN SEPARATORS.—J. P Ebert, Lake Mills, Iowa. The purpose in this case is to provide details of construction for racks, which are adjuncts of a grain separator, whereby positively continuous and regular feed and reciprocating motion of the racks is secured, and a reliable separation of the grain from the straw is produced while the threshing is being conducted.

PLOW-BLADE.—O. S. Jewett, Lordsburg, Cal. The object here is to provide a blade, which in suitable number are radially arranged and secured in lapped engagement with each other and with clamping disks, whereby a spade-like wheel is produced that in series is secured on an axle at suitable intervals, said axle being journaled on a frame that is adapted for progressive movement

CULTIVATOR.—A. Brigham Albertville, Ala The object of the invention is to produce a cultivator of simple construction the teeth of which may be adjusted so as to change their distance apart as may be desired and further to provide a construction which will enable the teeth to be adjusted as to their elevation to adapt the implement for use on a hillside or ridge

PLANTER. — A Brinkoetter, Floresville, Texas. This planter is without springs inside of the seed box which are apt to be choked or gummed by the seed or dust. The invention provides bottom plates and feed plates of different sizes, which may be used with seeds of different sizes, and also for seed which are to be planted a greater or shorter distance apart

AGRICULTURAL IMPLEMENT —A C Nelson, Nelson Township N D This invention relates more particularly to such implements as are known as potato forks, and each of which in general consists of a head having a fork integral therewith the latter being provided with a plurality of tines, a shaft having a handle at its upper end pivotally secured to the head, and means for locking the shaft in a plurality of positions on the head.

Of General Interest.

CURRENT MOTOR – C A Neyland, Spokane Wash. This invention relates to wave or current motors of a class that utilize the force of a moving body of water such as a flowing stream or tidal action for useful effect The purpose of the invention is to provide novel features more particularly for the current motor formerly patented by Mr Neyland

RELEASING DEVICE C Hunt, New York N Y The intention here is to provide a device arranged to permit instant releasing of the boat lowering means from the boat as soon as the latter reaches the water, thus allowing the crew to quickly pull away from the vessel and thus prevent the boat from injury by bumping against the side of the vessel especially if a heavy sea should prevail at the time

APPARATUS FOR CONSTRUCTING CONCRETE PIPES —F Teichman, San Francisco Cal In this patent the invention relates to concrete pipe constructions, the more particular object being to provide certain general improvements in the molds for cheapening the building of concrete pipes An advantage lies in the arranging of the plates of the inner mold into a general spiral form to facilitate the removal and replacement of the plates as the work proceeds.

FENCE-CLAMP P Garen Wytheville Va This invention is an improvement in fence clamps and relates particularly to the means whereby the lines of the wire of wire fences may be held for connection with the stretching device The construction is simple and by forming the opposing surfaces curved the wire will be tightly and firmly held and as the curve prevents slipping the clamp may be operated efficiently with fewer bolts than in ordinary constructions.

FASTENING —I Coleman New York, N Y The invention refers to eye glasses and spectacles and the object is to provide a device for securely fastening the frame and lenses together without use of screws, and use is made of a stud held in a post lug and extending through an aperture in the lens, the free end of the stud being engaged by a locking device having connection with the post

PROCESS OF MANUFACTURING SOLUBLE COMPOUNDS OF MERCURIC SALTS WITH HEXAMETHYLENE-TETRAMIN —A. Busch Brunswick, Germany The invention consists in the application of the discovery of a process in which, for instance, dry hexamethylenetetramin mercuric chlorid is mixed with an equal weight of an albuminoid, soluble in water, such as albumose peptone, alkali-albuminate, casein alkali or the like, and the mixture is dissolved in a soap solution, the mercury of the solution is in an organic form and no longer to be precipitated by the usual reagents for precipitation of mercury

CONCENTRATING-TABLE.—J W Meyers and D F Paine, Ely, Nev The table is such as used in concentrating the crushed ores of precious metals. Simple means are provided for maintaining a cover such as linoleum, in a taut condition the general object being to prevent buckling or formation of ridges or unevennesses in the cover, which usually necessitates the removal or replacing of the cover

Hardware.

ANTISAGGING DEVICE FOR DOORS.—C Lehman, Elgin, Iowa The purpose in this case is to provide a device which may be manufactured at little expense, and which is adapted to lift the door to a normal position after the wearing of the hinges causes it to drop out of normal position, the support being so constructed that it is certain of operation although the pintles of the hinges are out of alinement.

LOCK — H. C. Waldecker, Austin, Minn. This invention pertains to locks such as used on doors. It concerns itself especially with locks which employ a latch bolt for latching the door and a bolt for locking the door The latch bolt is withdrawn by turning the knob, while the locking bolt is operated by a key.

SAW-HANDLE.—R. D. Bowen, Oakville, Wash. The invention relates to fastening means employed for securing saw handles to cross-cut saws, and the special object is to so construct the fastening means that the parts cannot become accidentally loosened, which presents no obstructions or sharp points which might injure the hand of the workman and which can be readily dissembled to permit removal of the handle.

BRUSH —S. A. Van Breck, Belleville N J The purpose here is to provide a paint-brush or the like, in which the bristles are securely attached to the head of the brush in which the ferrule holding the bristles in position is compressed and partly imbedded in the head to hold it in place in which a comparatively small head can be employed for holding a large quantity of bristles, and in which the necessity of extensively nailing or otherwise securing the ferrule to the head is obviated.

PROTECTION NOZZLE FOR FIRE HOSE.—M J Mahone New York, N Y The production is of a nozzle having a construction which will enable a protecting sheet of water to be thrown out from the nozzle and between the firemen and the fire so that the firemen will be protected from the smoke and gases of combustion and to arrange the nozzle in a way that the sheet will not have the effect of producing a draft toward the fire

KEY RING TAG —H E Milleson Shelbyville, Ind Mr Milleson's invention consists in the forming of the tag of two separate plates, one constituting an identification plate and the other a stamp-bearing plate the two plates being so connected together that the stamp is normally protected yet may be readily exposed to view

BELT LACING TOOL.—J W Kane and W R Christie New York N Y This tool is adapted to be used in lacing the ends of belts together The invention consists in a gouge adapted to cut openings in the belt of any size desired and a slicing knife which is adapted to cut lacings for the belt of a size such that they will fill the openings cut by the gage.

LUBRICATOR FOR SAW BLADES G E. Hanzinger and S. J Rowan Greenville Miss The aim in this instance is to provide a lubricating attachment which may be easily operated when required whereby lubricant may be discharged at will upon the saw blade so that it is enabled to make a narrower and smoother kerf with less friction Thus lubricated a blade requires less set or spread of teeth and will do closer smoother work with less force

SICKLE SHARPENER -- O A Halversen Little Rock, Ark The sharpener is for use in connection with a grind stone and to provide means for clamping a sickle bar on a support mounted on the frame of the stone A universal joint permits movement of the sickle to give it the proper angle to the stone and a counter balanced sickle carrier is arranged to be raised or lowered and to be moved lengthwise along the stone so that the sharpening can be performed with quickness and convenience

STIRRUP —G W Hooke, Sourlake Texas The stirrups are made rights and lefts, the right being the exact opposite of the left and they will always hang in proper position for the insertion of the foot without twisting the stirrup leather The inner side will not chafe the body of the horse It may be made of any suitable material and form of body or foot plate to accord with the saddle

NUT LOCK —W R Garner, Palestine, Texas This improvement in nut locks is especially in that class of nut locks and plates designed for use on railroad joints frogs, cars bridges and the like as well as on engines iron fencing buggies, wagons, and otherwise where similar locks can be employed

Heating and Lighting.

PETROLEUM BURNER FOR INCANDESCENT LIGHTS.—F Hoff Berlin Germany This invention relates to burners which have a horizontal flange around the top of the outer wick. This flange is usually permanently connected with the outer wick tube but according to the present invention it is made independently thereof and is supported by the burner gallery, for instance, by means of arms or feet which are mounted on a ring fastened to the gallery

VACUUM VALVE FOR HEATING SYSTEMS.—F Shurtleff Moline Ill. In this patent the invention is an improved valve or combination of valves for maintaining a partial vacuum in a heating system. It is capable of use with any vacuum heating system or other apparatus where it is desired to prevent the return of air after it has been expelled

Household Utilities.

MATTRESS -P Klimowicz and J S Worzalla Stevens Point, Wis. This mattress is intended to provide a comfortable and healthful position to the person and to this end is constructed with an approximately transverse groove or depression in which the shoulder is adapted to sink, and a number of substantially longitudinal grooves intersecting the transverse depression to receive the forearm and a loose covering over the depressions.

COFFEE-POT -T J Clement Atlantic City, N J This pot has a percolator which can be readily introduced and removed The construction of the percolator is such that it holds itself fixed within the coffee pot the member which operates to hold the percolator within the pot operating also to hold the cover of the percolator in position.

SERVING-CUP FOR BEVERAGES.—T J Clement Atlantic City, N J. The cup in this instance is for use in serving beverages, and it has improved means for refrigerating the glass containing the beverage to the end that a beverage can be kept cold even if allowed to stand a considerable time after having been served.

DIPPING DEVICE FOR BOTTLES OR JARS.- R. W McGinnis Wichita, Kan The device is for use in holding bottles or milk jars when they are being dipped to sterilize or scald them It can be operated in a simple manner to hold a number of bottles in a convenient manner to enable them to be dipped in a vessel having a scalding or sterilizing bath.

DINNER PAIL.—A M Hunt Hampden Maine. The invention refers more particularly to devices for carrying food and the like which includes a number of traps for liquid and solid contents and which have means for holding heat-supplying substances such as burning coke or charcoal for maintaining the contents of the receptacle in a heated condition

BED —W H Cling Charleston S C This invention shows a form of invalid bed in which the mattress frame can be raised at the head and lowered at the foot to suit the necessities or convenience of the occupant Efficient means are provided for actuating the parts and for maintaining the intermediate portions of the mattress and the head portions of the mattress under the desired tension regardless of the adjustment of the bed

COVER FOR TEAPOTS —T J Clement Atlantic City N J This invention is a division of the invention described in a patent the application of which was formerly filed by Mr Clement The improvement is useful in connection with any pot on which a beverage may be brewed from leaves or grindings, or indeed it may be used in any connection where the contents of a serving vessel should be strained before serving

ADJUSTABLE SHADE SUPPORT —C P Westhauser New York, N Y In this patent the invention is an improvement in shade and such like supports the present embodiment of which belongs to that class of such devices in which the shade-supporting arms are adjustable to and from each other to accommodate shades of different length

Machines and Mechanical Devices.

STARTING DEVICE FOR THE COMPRESSED AIR MOTORS OF SELF-PROPELLED TORPEDOES.— A E. Jones Fiume Austria Hungary This invention consists in particularly connecting the delay action flap of ordinary construction with the reducing valve of the pressure reducer arranged between the compressed air reservoir and the motor for dispensing with the moderating part of the air admission valve ordinarily arranged between the reducer and reservoir and the auxiliary air supply valve for disengaging or operating the gyroscope thereby simplifying the mechanism of the torpedo while rendering it more certain in its operation

GRINDING AND PULVERIZING MILL. J J Knight, Alameda Cal The invention relates more specifically to a mill in which communicating rollers are arranged in concentric circles upon a supporting member and have concentric pressure rings arranged upon each circle of rollers and held resiliently and adjustably in position thereupon to force the rollers firmly against the supporting member

WASHING MACHINE R Twohig, Salina Kan The intention is to provide a machine which can be driven by hand or by power in which clothes, household linen etc can be laundried efficiently in which the cleansing is effected by the pounding action of a beater upon the articles which are immersed in a washing fluid such as soapy water and in which the articles are positioned preferably upon a perforated false bottom

ROTARY VALVE S Yankauer New York N Y An object of this invention is to provide a valve in which the valve plug is resiliently held in place so that leakage is effectively prevented and in which the rotation of the valve in opening and closing the same tends to continually grind the valve plug and seat and maintain a perfect fit

GRADER OR DITCHING MACHINE —W L Davis Wabbaseka Ark The invention comprises a pair of blades or boards which are disposed at an acute angle to each other the arrangement being such that when the implement is advanced one of these blades or boards presents itself in an inclined position so that its lower edge will operate as a scraper on the surface of the earth

MOUNTING FOR BOTTLE WASHING BRUSHES A N Davis New York N Y In the present patent the invention has reference to mechanism to be used in connection with bottle washing brushes the inventor's more particular purpose being to produce a mounting provided with a spring-controlled mechanical movement for holding the brushes in good position for washing the bottle

WRAPPING TWISTING AND POLISHING MACHINE —W J Carey Trenton N J The purpose here is to provide a machine arranged to cover a plurality of wires or cores with paper or like wrapping material and then polish the covered cores and twist the same into a single strand in an exceedingly simple manner and in one operation

PARACHUTE.—T L. Zook, Lima Ohio In

this parachute rigid guys or braces operate in conjunction with a sail or kite to extend it and the inventor's objects are to provide means for effecting the opening of the parachute in descent, to afford facilities for folding and stowing the device and to provide a durable and simple construction of the several parts of the parachute and its entirety.

CAPPING MACHINE.—C. A. YOUNGMAN, Louisville, Ky. The intention of the inventor is to provide a machine arranged to press the cap or capsule snugly onto the head and neck of the receptacle without danger of marring the cap or capsule, or scratching or removing the paint, wax, or other material with which the cap is decorated.

Railways and Their Accessories.

SWITCH MECHANISM.—F. F. YOUNG, Lowell, Ohio. The invention pertains to railway switches, and particularly to the switches of light railways such as trolley tracks. The inventor's aim is to provide means for operating the switch from the car platform so as to obviate the necessity for operating the switch by hand.

AUTOMATIC SWITCH-STAND.—E. K. STAGGS, Hachita, New Mex. An object here is to provide a switch in which the target will always indicate the true condition of the switch. This obviates a grave danger which arises from the use of switch stands of the ordinary kind since with this invention there must be a positive movement by some one who wishes the switch to be changed before the target will indicate such change. The change made, the target will be shifted to indicate the change and will be positively locked in its shifted position.

LOCOMOTIVE ASH PAN.—J. S. DOWNING, Atlanta, Ga. The inventor's object is to provide a novel positively operating construction for discharging ashes from the ash pan. This is an automatic self-cleaning ash pan having a system of hoes attached to the piston rod and a cylinder adapted to receive fluid pressure for reciprocating the hoes in the ash pans for discharging the ashes thereon.

RAIL CHAIR AND BRACE.—E. JANDEBAU, Cherry Valley, N. Y. The object of the invention is to provide a chair and brace by means of which railroad rails can be securely held in place upon the cross ties and which serve to brace the rails against lateral movement at curves and other points of the track where such bracing is necessary.

METALLIC CROSS TIE AND RAIL CLAMP.—H. S. KILBOURNE, Washington, D. C. An object of this invention is to provide a cross tie of light weight but strong and durable. In carrying this out I-beams of standard sizes and shapes are used, thereby reducing cost of manufacture. The tie requires but few bolts, the main connecting member being a clamp of a peculiar form.

Pertaining to Recreation.

MOVING PICTURE DEVICE.—W. HENBRICK, New Haven, Conn. The object of the present invention is to provide certain improvements in chaplets and shrines of the holy rosary whereby actuating mechanism is employed and the endless web containing pictures is properly actuated to accurately display one of the pictures at a time and to display the several pictures in the proper order according to the intended devotional exercise.

Pertaining to Vehicles.

THILL-COUPLING.—V. B. HENRY and H. FINTEL, Jr., Hardy, Neb. The main object in this case is to provide an improved means for enabling the draft eye to be detached or inserted while at the same time means are provided for holding the draft eye in close contact with the coupling pin to prevent rattling of the various parts.

POLE TIP.—J. W. DEAN, Geary, Okla. The invention relates to tips for wagon poles and the like, and more particularly such as have resiliently controlled means for securely holding a neck yoke in place on the pole. In operation the latch cannot drop out through the slot of the casing, as the stop with its shoulders which are transversely disposed with respect to the slot, is covered by the end of the pole.

PNEUMATIC TIRE.—P. J. VIEL, 87 Rue de Rivoli, Paris, France. This invention relates to a tire characterized by the use of a lining formed of a metal cable of wire. This packing or lining is intended to entirely do away with ruptures resulting from excessive pressure or excessive weight or overheating and punctures. This lining diminishes in no way the flexibility of the tire.

BOLSTER.—J. HEIMLICHER, Defiance, Ohio. The aim in this instance is to provide a bolster for wagon bodies and the like which is light in weight and inexpensive to manufacture and which can be easily fashioned from standard structural iron or other metal pieces, such as I beams and channels.

Designs.

DESIGN FOR A CUT GLASS DISH.—T. B. CLARK, Honesdale, Pa. This highly ornamental dish is of a circular form and its height is about one half the diameter of the top and open part. The pattern cuttings are of great variety and exquisite design.

DESIGN FOR A TOBACCO PIPE.—J. M. TAVPA, Athens, Texas. The bowl in this ornamental design represents the body of a tree with several roots sawed off close at the base. The handle has a symmetrical curve. The words Dum Tacket Clamet are inscribed across the bowl and also large initial letters W O W arranged vertically.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

THE COMMERCIAL PRODUCTS OF INDIA. By Sir George Watt. New York: E. P. Dutton & Co., 1908. 8vo., 1189 pp. Price, $5.

This work is an abridgment of "A Dictionary of the Economic Products of India," which was published in 1893-4, and which has been out of print for some time. The government of India therefore decided that a correct and abridged edition should be brought out. The instructions provided that the work should be limited to a single volume, the arrangement of which should follow that of the dictionary and should be confined to products which are at present of prospective industrial and commercial importance. The book is a monumental work, and represents a vast amount of labor. It will prove valuable to those who are in any way identified with Indian industries.

THE PHOTOGRAPHIC MANUAL. Edited by H. Snowdon Ward. London: Dawbarn & Ward, Ltd. New York: Tennant & Ward. 12mo., 287 pp. Price, paper, 50 cents, cloth, $1, postage extra.

This is the fifth edition of an excellent English manual which incorporates the figures, facts, and formulæ of photography, and is a guide to their practical use and is intended for all photographers. This collection of formulæ is one of the best that we have ever seen. It is a book which should be in the hands of every photographer.

THE ANGLER'S GUIDE. A Manual for Campers and Anglers. Edited by Wainwright Randall. New York: The Field and Stream Publishing Company, 1909. 16mo., 242 pp. Price, 50 cents.

This little volume contains a description of all popular fresh water and salt water fish. It describes tackle and bait for the expert angler. It gives complete information on how, when and where to fish, and a summary of the fishing resorts of the United States and Canada. The book is admirably arranged, and is very well printed. Its form is so convenient that it can be carried in the pocket. Among the features which appeal to us particularly are the views and plans of bungalows, the fishing charts, and the directions for preparing food suitable for a fishing camp. The book should be in the possession of every fisherman.

THE DIRECTORY OF DIRECTORS IN THE CITY OF NEW YORK. New York: The Audit Company, 1909. 12mo., 860 pp. Price, $5.

The tenth edition of this useful work has just come from the press, and maintains the reputation of its predecessors for completeness and reliability. The Directory this year contains over 32,000 directors, each director's name being followed first by the name of the firm or company with which he is directly associated, and then by all the companies in which he is a director. Select lists of corporations in banking, insurance, transportation, manufacturing, and other lines of business, alphabetically arranged, accompanied in each case by the names of the company's officers and directors, are to be found in the appendix, as well as a list of the principal exchanges in New York, with their officers and managers. This is a book which no business house dealing with a large number of companies or their stocks and desiring to know by whom their clients' interests are controlled, can afford to be without.

THE IMPLEMENT BLUE BOOK. St. Louis: Midland Publishing Company, 1909. 8vo., 460 pp.

This is a very useful book of reference for all users of or dealers in vehicles of all kinds, agricultural machinery and implements. A remarkable feature is the simplicity with which one can find any name or subject heading one wants, the book being described as "self-indexed, double-indexed and cross-indexed." It begins with a classification of manufacturers in the alphabetical order of the implements they make, following with vehicles in the same manner. Then comes a list of manufacturers in alphabetical order, with lists of the specialties they make, and then a list of branch jobbing and transfer houses in geographical order, with the names of manufacturers whose lines they handle.

ENGINE LATHE WORK. By Fred H. Colvin. New York: Hill Publishing Company, 1909. 16mo., pp. 180. Price, $1.

The writer is Assistant Editor of the American Machinist, and is the author of many well-known books on mechanical subjects. The present volume gives practical suggestions which will give the young machinist or apprentice the foundation principles of engine lathe work. The illustrations number 127, and are well executed. The author states that while the suggestions have been written especially for those with a limited experience, it is quite probable that many of the ideas and suggestions may be new to some of the older men who have not had a chance to see what other shops were doing.

RADFORD'S ARTISTIC BUNGALOWS. Unique Collection of 208 Designs. Chicago and New York: The Radford Architectural Company, 1908. 4to., pp. 221. Price, $1.

In the last three years the number of bungalows which have been built in the United States has increased by leaps and bounds, and whole farms are being split up into lots for the erection of bungalows consisting of from two to five or more rooms. The work before us consists of a collection of wash drawings and floor plans. Plans and specifications for any of them are furnished by the publishers at moderate rates. The illustrations are hardly as attractive as they would be if they were made from photographs of bungalows which have actually been built.

THIRD REPORT OF THE WELLCOME RESEARCH LABORATORIES AT THE GORDON MEMORIAL COLLEGE, KHARTOUM. Andrew Balfour, M.D., B.Sc., F.R.C.P. Edin., D.P.H. Camb., Director. Published for Department of Education, Sudan Government, Khartoum, by Bailliere, Tindall & Cox, 8 Henrietta Street, Covent Garden, London. Depot for U. S. A.: Toga Publishing Company, 45 Lafayette Street, New York city, 1908. 4to., pp. 476.

The admirable work conducted in the Wellcome Research Laboratories is undoubtedly familiar to our readers. The laboratories were established to promote technical education in general, to further the study of tropical disorders, especially the infective diseases of both man and beast peculiar to the Sudan, to render assistance to the officers of health and to the clinics of the civil and military hospitals, to aid experimental investigations in poisoning cases by the detection and experimental determination of toxic agents, particularly the obscure potent substances employed by the natives of the Sudan, to carry out such chemical and bacteriological tests in connection with water, food stuffs, and health and sanitary matters as may be found desirable, to promote the study of disorders and pests which attack food and textile produce and other economic plant life in Sudan, and to undertake the testing and assaying of agricultural, mineral and other substances of practical interest in the industrial development of the Sudan. The two volumes of reports previously issued by the laboratories cover the period from the foundation of these laboratories in 1903 to 1906. The third report completes the record up to 1908. The work of the laboratories has been so far extended that the latest report contains some 480 pages or detailed records of many interesting experiments, and researches principally connected with tropical medicine. The volume is profusely illustrated and includes many valuable colored plates. Simultaneously with the Third Report and as a Supplement to it is published a Review of the Progress made in Tropical Medicine during recent years, compiled by Dr. Balfour and Dr. R. G. Archibald.

DICTIONARY OF CHEMICAL AND METALLURGICAL MACHINERY, APPLIANCES AND MATERIAL MANUFACTURED OR SOLD BY ADVERTISERS IN ELECTRO-CHEMICAL AND METALLURGICAL INDUSTRY. First Edition. New York: Electro-Chemical and Metallurgical Industry, 1909. 12mo., pp. 182. Price, 50 cents.

LA MORPHOLOGIE DE L'INSECTE. Par Charles Janet. Limoges, France: Imprimerie-Librairie Ducourtieux et Gout, 1909.

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A NEW SPEED INDICATOR FOR MARINE PROPELLERS.

(*Continued from page 156*)

function enters largely Each marine plant has its most efficient cruising speed, and in the case of cargo-bearing merchant marine vessels, every pound of coal saved means increased earnings also increased cruising area to warships. When this economical speed had been determined, with a tachometer system consisting of a plurality of indicators distributed about the vessel to guide, the engines can be kept at this rate of speed accurately and with but slight effort. The captain, in his cabin or on the bridge the chief engineer when off duty—all can keep track of exactly what rotation speed is being maintained

The accuracy of dead reckoning is greatly facilitated by an exact knowledge of what engine speeds have obtained during stated and frequent intervals of time instead of having to take the total number of revolutions over a protracted period and guess roughly at the distance traveled, because the distance traveled per minute by the ship at say 100 R P M is not increased in proportion when 125 R P M. obtains. Therefore, during long periods the rate of speed of the shaft may vary considerably with no tachometer to guide the man at the throttle.

Efforts along this line have been made for a number of years but have been productive of no dependable and accurate device prior to the invention of the system which is the subject of this article

Centrifugal devices are not susceptible to mechanical transmission to various remote parts of the vessel, and lack extreme accuracy over protracted periods of operation Pneumatic devices operated by air-pumps actuated by the propeller shaft are less accurate Electrical tachometers have failed in accuracy heretofore because of the error introduced, and varying from day to day by rubbing or abutting contacts becoming foul, thereby introducing a resistance in the circuit with corresponding inaccuracy of reading of a voltmeter operated by the dynamo calibrated in R P M of the propeller shaft Owing to the former use of direct-current instruments commutators and brushes were necessary on the magneto The spring tension of these brushes varied the commutator became oxidized and covered by oil from the bearings, and considerable error crept in As a warship going ten knots per hour with engines turning over 72 R P M is not traveling ten knots at 71 or 70 R. P M, it is seen that a tachometer, to be of value, must be accurate to a fraction of a revolution, and maintain its calibration

All reciprocating engines owing to the use of connecting rods between the crank and the piston impart rotation to their shafts of constantly varying angular velocity The fewer the number of cylinders or the slower the speed of rotation the greater this variation These variations are smoothed out more or less by the *flywheel on the stationary engine* but a marine engine has no flywheel except a propeller the weight of which is not sufficient to possess flywheel action to any extent Therefore, any tachometer actuated by the propeller shaft by gearing or otherwise, has imparted to it an unsteady rate of speed If the tachometer is geared up to the shaft so that it will rotate faster than the shaft, any momentary irregularity in the revolution of the main shaft is multiplied in the tachometer proportionally to the ratio of gearing between the main shaft and the tachometer Therefore whatever indicating device is used in connection with the tachometer will pulsate, and the reading of the pointer on the scale of the instrument will be largely a matter of guesswork between two values of low and high. Hence it is evident that some sort of compensating device must be used to take up these momentary fluctuations of the propeller shaft, and impart to the generator of the tachometer a steady av-

(*Continued on page 168.*)

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EXPERIMENTS WITH A LAMP CHIMNEY In this article it is shown how a lamp chimney may serve to indicate the pressure in the interior of a liquid, to explain the meaning of capillary elevation and depression to serve as a hydraulic tourniquet an aspirator and intermittent siphon to demonstrate the ascent of liquids in exhaustive tubes; to illustrate the phenomena of the bursting bladder and of the expansive force of gases. Scientific American Supplement 1582.

HOW A TANGENT GALVANOMETER CAN BE USED FOR MAKING ELECTRICAL MEASUREMENTS is described in Scientific American Supplement 1594.

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SIMPLE WIRELESS TELEGRAPH SYSTEMS are described in Scientific American Supplements 1363 and 1381.

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[illegible] up or acceleration of the engine.

A tachometer has recently been perfected by Mr. Miller Reese Hutchison, in which these defects are avoided by very simple and dependable means.

The accompanying illustration shows a merchant marine generating set of this electrical tachometer, installed in the shaft alley of a steamer.

The large split sprocket wheel *B*, of proper diameter to conform to the shaft *A*, is firmly clamped thereto. A Morse silent chain *C*, engaged by the sprocket wheel *B*, drives a similar sprocket wheel *D* mounted on a countershaft *E*, which forms part of the tachometer generating set. The rotation of this small sprocket is transmitted to the flywheel *F*, keyed to the countershaft *E*, through the intermediary of two opposite coiled spiral springs *G*, *H*. Inside the rim of the flywheel *F* and on the end opposite to the spiral springs *G*, *H*, gear teeth are cut which engage two pinions. These pinions respectively actuate magnetos *XY*. It is seen that any momentary fluctuation in the rotation of sprocket *D*, occasioned by variations in the angular velocity of the main shaft *A* are smoothed out by the springs *G*, *H*, imparting to the flywheel *F* and countershaft *E* a steady average speed. To protect the springs *G*, *H*, against rupture from sudden reversal of rotation of main shaft *A*, stop pin *K* is mounted on the flywheel, and engages radial arm *L*, mounted on the sprocket wheel *D* thereby preventing more than one-half an independent revolution of the countershaft. This one-half revolution is sufficient to take care of practical conditions on marine equipments.

The magnetos *XY* are of the inductor type. The armatures and the pole pieces are stationary. 1 is a permanent magnet of finest steel, properly aged to insure absolute permanence. 2 2 are the pole pieces of soft iron attached thereto. 3 is a stationary shuttle armature, on which is winding 4. Rotating between the pole pieces and the armatures is the soft iron inductor 5. As the inductor is rotated an alternating electromotive force is generated in the armature, two cycles per revolution.

The magneto is so designed that the voltage is directly proportional to the speed of rotation of the inductor, over a wide range. Therefore, the faster the propeller shaft turns, the higher the voltage directly proportional thereto.

It will be noted there are no commutators or brushes, the armature being stationary and the leading-out wires soldered to the main line wires. Therefore no error can creep in from increase of resistance of contacts.

The indicators are alternating-current voltmeters of the dynamometer type, i. e., having a moving coil and stationary coils.

In present practice, however, alternating-current voltmeters read but one way, with the zero on the left of the scale. A tachometer, specially for marine use, must show direction of rotation of main shaft as well as the speed. In the design of this, therefore, the zero is at the center, deflections of the pointer to the left indicating speed of rotation of the propeller shaft astern, and to the right ahead.

The pointer of the indicator is deadbeat at its reading, and is not influenced by the rolling or pitching of the ship. Provision is also made to protect the instrument against concussion or atmospheric disturbance from heavy gunfire.

In the naval type each indicator is entirely independent of all the rest, being connected to its own pair of magnetos; hence, should one indicator be shot away or otherwise damaged, it will not affect the reading of any of the other indicators.

In the merchant marine type, however, this is not deemed necessary, [illegible]

(Concluded on page [illegible].)

[illegible]	931,[illegible]
[illegible] pump, [illegible], W. E. [illegible]	931,[illegible]
Pump for [illegible], E. E. [illegible]	931,[illegible]
Pump [illegible], W. Morgan	931,[illegible]
Pump, centrifugal, F. [illegible]	931,[illegible]
Pump, piston, H. P. Wells	931,[illegible]
Punching machine, W. E. Kilgore	931,431
Push button apparatus, E. D. Bark	931,[illegible]
Radiator [illegible], F. J. Perkins	931,[illegible]
[illegible], H. W. Cadwell	931,677
Rail [illegible], C. R. Weaver	931,104
Rail joint, [illegible]	931,117
Rail joint, [illegible]	931,[illegible]
Rail joint, Frederick & Chapman	931,[illegible]
Rail joint truss support, L. Mueller	931 [illegible]
Railway cattle guard, J. E. Wheeler	931,587
Railway construction, M. C. Grant	931,418
Railway frog, E. L. Morgan	931,073
Railway joint, D. E. Coupland	931,273
Railway overhead line construction, electric, T. Varney	931,354
Railway, pleasure, G. M. Perdew	931 705
Railway signal, H. B. Andrews	931,[illegible]
Railway spike, C. L. Columbia	931,272
Railway switch, O. D. Jefcoat	931 428
Railway switch, automatic, G. E. [illegible]	931 650
Railway tie, J. F. Schneider	931,226
Receptacle, wooden, H. H. Horr	931,604
Reflector, lantern, O. A. Prunner	931,462
Rein or neck strap line terret, S. M. Harsh	931 [illegible]
Reinforcing bar, A. M. Lindau	931,[illegible]
Releasing device, C. Hunt	931 122
Resinous matter recovering, W. J. Hough	931 [illegible]
[illegible]	931 [illegible]
[illegible] apparatus, G. [illegible]	931 601
Rheostat, multiple switch, O. S. Schairer	931,146
Ring traveler holding and delivering means, J. C. Edwards	931 690
Rivet setting machine, A. E. Havener	931,068
Rock drill, W. M. Porter	931,470
Rock drill or boring tool, J. Hutchings	931,611
Rod. See Fishing rod.	
Rolling mill tube trough, Worth & Harrison	931,542
Rolling pin, H. E. Fendring	931,[illegible]
Rotary engine, C. McGowan	931,077
Rotary machine, C. G. [illegible]	931,088
Routing machine guide device, W. H. [illegible]	931,[illegible]
Rubber, ebonite, or vulcanite manufacturing goods of, O. C. [illegible]	931,210
Rubber like gum from [illegible] vegetable sources, extracting, F. H. Hunicke 931,120	931,121
Sad iron, self heated, A. H. Davis	931 [illegible]
Safety switch, J. T. Krieger	931,[illegible]
Sand blast blower, D. & M. Doublet	931,579
Sash lifter, E. Corbin	931,[illegible]
Sash lock, J. L. [illegible]	931,194
Sausage machine, J. [illegible]	931 [illegible]
Saw feeding mechanism, H. B. Ross et al	931,[illegible]
Saw frame, flexible, C. [illegible]	931,424
Saw set and clamp, F. W. McLean	931,076
Scale, coin controlled beam, W. H. Jordan	931 489
Scarf holder, E. H. Ross	931,147
Seal, J. A. [illegible]	931,670
Seal, car, F. W. Brooks	931,379
Separator, A. J. Morlock	931,457
Sewing machine attachment, C. D. Armstrong	931,369
Sewing machine grinding attachment, G. I. Green	931,597
Sewing machine looper mechanism, F. E. Valois	931,[illegible]
Sewing machine, overseaming, A. Grieb	931,088
Sewing machine ruffler, W. H. Parsons	931,041
Sewing machine shuttle and accessories, rotary, J. O. Huffman	931 610
Sewing machine work clamp operating device, F. H. McLaughlin and R. M. Hughes, Jr	931,700
Shade roller bracket, adjustable, C. E. Sprague	931,514
Shaft construction, F. M. [illegible]	931,436
Shaft hanger, H. La Casse	931,139
Shearing machine, C. M. Palmer	931,141
Shingle or tile, roofing, F. W. Mayer	931,[illegible]
Shock absorber, G. Bank	931 671
Shoe and fastener therefor, L. O. Lindberg	931 441
Shoe, sporting, W. J. Riley	931,543
Sifter, ash, J. Farnworth	931 191
Sifter, ash, J. Markey	931,446
Sign, advertising, J. W. Ellis	931 186
Sign, luminous, P. L. Clark	931 026
Signal, E. L. Cairncross	931,[illegible]
Signal device, H. J. Heeney	931 674
Signal system, supervisory, C. F. Patterson	931,704
Silk product and treatment of silk, J. Knup	931,[illegible]
Silo packer, G. E. Rogers	931 090
Siphon, S. F. Miller	931 458
Skate roller, J. H. Hollar	931 064
Skirt trimmer, E. O. Bleckschmidt	931 257
Sleeve closure, W. S. Harker	931 349
Smoothing iron, S. O. Buckard	931,381
Snap hook, T. Forstner	931,[illegible]
Snow plow, C. A. [illegible]	931 550
Solder for aluminium, Z. [illegible]	931,[illegible]
Sole edge burnishing machine, E. Beaudry	931 558
Sole, galvanic, Kennedy & Davis	931,065
Spectacle frames, manufacturing, S. H. Simonds	931,506
Sprayer, D. O. Bowman	931,050
Spraying device, air chamber liquid, A. M. Phillips	931,[illegible]
Spring wheel, L. Flum	931 048
Spring wheel, W. H. Wildrick	931,341
Spur, folding, J. D. Hayes	931,063
Stalk cutter, J. A. McKay	931 [illegible]
Stamping machine, E. H. Wilhelm	931,170
Steel, method and apparatus for treating, W. E. Nickerson	931,[illegible]
Steels for industrial purposes, treatment of, E. Schneider	931,[illegible]
Stencil, T. C. Hough	931 [illegible]
Stirrup, G. W. Hooks	931,607
Stoker, underfeed fuel, O. Weiland	931,[illegible]
Stopper, E. Friedman	931,406
Stopper, H. J. Morrison	931 [illegible]
Stove, gas cooking, L. Kahn	931,312
Stove, heating, A. K. Beckwith	931,374
Stovepipe holder, J. M. Queen	931,[illegible]
Strainer, E. H. Carlisle	931 [illegible]
Strainer or cooker, vegetable, W. Leitten	931,070
Street inlet and water closet flush, automatic odorless, self-cleaning, J. Pratt	931,481
Structural parts, means for preserving, A. [illegible]	931,[illegible]
Sugar, producing milk, A. A. Denham	931,[illegible]
[illegible] holder, S. H. Atkinson	931,371
Surgical knife, R. Heitmann	931,612
Sweep rake, Brown & Keithly	931,675
Switch key, E. H. Holland	931,[illegible]
Swivel hook, W. E. Clarkson	931 370
Syringe, A. Bean	931 118
Tag fastener, Harris & Flood	931,420
Talking machine stylus replenishing mechanism, [illegible] & [illegible]	931,076
Tanks from bursting by freezing, means to prevent, A. Ballard	931 112
Tap, Turner & Digman	931,[illegible]
Telegraph and selective system therefor, automatic, A. C. Gilmore	931,065
Telegraph and telephone pole, J. H. Ellis	931,[illegible]
Telegraph pole arm, L. Tyreman	931 [illegible]
Telegraphy and telephony receiver for wireless, G. [illegible]	931,[illegible]
Telephone desk stand, J. A. [illegible]	931,179
Telephone exchange selector, automatic, F. E. Loveridge	931,073
Telephone exchange switchboard apparatus, J. L. McQuarrie	931,[illegible]
Telephone exchange system, measured service automatic, W. W. Leach	931,[illegible]
Telephone instrument mounting, H. E. Shreeve	931,[illegible]
Telephone key, J. L. McQuarrie	931,[illegible]
Telephone service rent collecting means, E. [illegible]	931,[illegible]
Telephone system, private branch intercommunicating, J. L. McQuarrie	931,[illegible]
Telephone system, private branch intercommunicating, E. E. Holland	931,[illegible]
Telephone transmitter, A. G. [illegible]	931 137
Telephone transmitting mouthpiece, [illegible]	931,[illegible]
[illegible] machine, H. O. [illegible]	931,[illegible]
[illegible]	
[illegible], A. L. [illegible]	931,[illegible]
[illegible], V. [illegible]	931,[illegible]
[illegible], E. L. Daly	931,[illegible]

(Concluded from page 168.)

of magnetos supplying all the indicators, which are connected in multiple.

A very important fact in Mr Hutchison's system is the use of an exceedingly small current value and low voltage hence, in the event of the indicators being located in proximity to ammunition, should the circuit be opened by the breaking of a wire or otherwise, the resultant spark is barely perceptible and cool, therefore incapable of igniting anything. Should the line become short-circuited, no heating effect whatever is produced and no damage done to the magnetos, as they can run for an indefinite time on dead short circuit No effect is produced on the compass by the current in the wires and taken all in all the system seems to meet every requirement of accuracy and safety

◆

POWERFUL HOISTING AND CONVEYING MACHINE

(Continued from page 156)

in the machinery house at the pier end of the bridge, the power from which is transferred to the moving gear wheels by a line of shafting on top of the bridge thence to lines of shafting down the pier and shear supports, and thence by a proper train of gears to the wheels.

The moving gear mechanism is attached to the operating mechanism by means of friction clutches, so arranged that the motion of the crane may be made in either direction at the will of the operator Further provision is made for disconnecting the gearing in order to skew the bridge within the limits given

The main operating mechanism for the bridge is located in the machinery house, and consists of two drums. Each of these drums is mounted loose on its supporting shaft Each drum is controlled by a Brown friction clutch and a band friction brake The drums are connected one to the other through an equalizing gear mechanism which is equipped also with a powerful foot brake so that the two main operating drums may be made to rotate in opposite directions with the same speed This feature of connecting the two drums is one of the all important points in the Brown two-drum operating mechanism The main operating machinery is further arranged to operate from the intermediate shaft the bridge crane moving gear mechanism to which the supporting truck wheels are connected by shafting and gearing This mechanism is controlled also by a powerful clutch and band friction foot brake

In further connection with the two main operating drums is a small closing drum which, in conjunction with the two main drums controls all of the motions of hoisting and lowering the load and traveling the trolley The trolley, which in reality forms also a part of the main hoisting mechanism, is specially designed to operate in conjunction with the drum arrangement above described In general, this trolley consists of a steel structural frame mounted on four turned cast-steel track wheels arranged to run on the trolley runway of the bridge crane. In the trolley there are mounted specially-designed drums which run loose on their supporting shafts. The large section of each drum on the trolley is connected to the main hoisting drums in the machinery house in the following manner

One length of wire rope will connect, from the under side one of the main hoisting drums to the top side of one of the large sections of the trolley drums. The under side of this trolley drum is connected by wire ropes to the top side of the other main hoisting drum The top side of this same hoisting drum is connected by suitable cable to the top side of the other trolley drum, and likewise this trolley drum from the under side is connected to the underside of the other main hoisting drum. By this arrangement of ropes, if one of the main

(Continued on page 170.)

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Inquiry No. 9020.—Wanted the addresses of the manufacturers of metal novelties.

(Continued from page 169.)

hoisting drums is connected through its clutch mechanism to the driving shaft, and the other main hoisting drum is allowed to work through the equalizing gear mechanism loose on its supporting shaft, the motion of the drums will be in opposite directions and with the same speed, and when working under this condition the motion produced on the trolley drums will be *nil*, thus giving to the trolley a motion or translation along its supporting runway and by the reversal of the motion of the main hoisting drums the trolley will be traveled in an opposite direction. Further if the main hoisting drums are both rotated in the same direction the drums on the trolley will be rotated in opposite directions with respect to one another and by the proper reeving of the ropes from the small drums on the trolley, the suspended load may be raised and lowered by the reversal of the motions of the main hoisting mechanism. When equipped with grab bucket, the opening and closing of the same is accomplished by the ropes leading from one of the main trolley drums. The shell lines from the grab bucket are attached to the other of the main trolley drums and for the same reasons as given above the bucket may be raised and lowered. But to carry out the motion of opening and closing the two main hoisting drums in the machinery house are held stationary and the small auxiliary hoisting and closing drum is put in operation. This drum is connected to a sliding loop attachment located at a convenient point on the bridge structures and in such a way that the ropes leading from the large section of the drum controlling the opening and closing lines of the bucket are reeved through this sliding loop mechanism and by the operation of this closing drum the one set of lines leading to the trolley is lengthened while the other set is shortened. By this means the one drum, controlling the opening and closing of the bucket, may be rotated in either direction by the proper operating of the closing drum above referred to. From this description it will be seen that in reality the main hoisting mechanism consists of the two main hoisting drums and the auxiliary closing drum, all of which drums are under the complete control of the operator, and work in conjunction with one another to properly carry out the various motions of the trolley and its load.

In the operation, however of the scoop bucket, with which the above bridge crane is equipped, only one main drum on the trolley is used, this being the drum operating the shell lines of the grab bucket. The lines leading from the small drum sections of this main drum are arranged to work in parallel and carry the shovel bucket. All of the clutches, brakes etc. going to make up the main operating machinery are connected to the operator's cage by suitable rods and levers so that the entire mechanism is under the complete control of one operator.

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(Concluded on page 172.)

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(*Concluded from page 170*)

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◆

MEASURING A RIVER'S FLOW.

(*Concluded from page 160*)

the velocity recorded at a number of different depths in each strip By the vertical integration method the meter is moved at a slow uniform speed from the surface of the stream to the bottom and back again

For convenience of reference and comparison the results obtained are plotted in the form of a curve on a chart.

Another illustration shows the Great Falls of the Missouri River in Montana A gaging station at the point from which the photograph is taken was established by the Geological Survey in July 1902

The river is favorable at this point for water power development and shows the kind of stream apart from navigable rivers, measured and reported upon by the Survey In this way the Survey constantly brings to the attention of the investing and developing public many previously unnoticed but valuable water-power sites

We are indebted to the director of the U S Geological Survey for the use of the accompanying illustrations.

◆

THE AVIATION MEETING AT RHEIMS

(*Concluded from page 170*)

with their Bleriot monoplanes Both Bleriot and Curtiss tried to lower their speed records for one circuit of the course, and the latter succeeded in making 2 seconds better time than before His time of 8 09 1/5 corresponds to almost 45 7 miles an hour Bleriot made the circuit in 8 08 2/5, which was 4 seconds slower than formerly

At the end of 2 hours, 22 minutes, and 51 seconds, Farman had flown 140 kilometers (86 99 miles) and beaten Paulhan's record. It was getting dark rapidly and the spectators could only see the machine as it passed before the grand stand Ten minutes and 19 seconds later he completed his fifteenth round, and less than five minutes later he had beaten Latham's record. One hundred and sixty kilometers (99 4 miles) were covered in 2 43 35 2/5, and 180 kilometers (111 88 miles) in 3 hours, 4 minutes, 55 2/5 seconds. As it was now 7 30, the nineteenth round afterward made by Farman was not counted in the official figures. He actually covered over 190 kilometers (118.06 miles) and remained in the air all told about 3¼ hours. As he finished in front of the grand stand a searchlight was thrown upon him He was pulled from his machine and carried upon the shoulders of his friends, receiving a decided ovation Thus, for the second time, he has won a $10,000 cash prize, the first instance being when he flew 1 kilometer in a closed circuit on January 13th, 1908 It is possible that he will try again to win this sum by making the 140-mile flight from New York to Albany In the flight for the Grand Prix, he carried enough fuel to fly 3½ hours.

The other prizes awarded in the Grand Prix de la Champagne distance race were as follows

Second, $5,000, won by Hubert Latham on his Antoinette monoplane. Distance, 154.5 kilometers (96 miles)

Third, $2,000 won by M Paulhan with his Voisin biplane. Distance, 131 kilometers (81 4 miles)

Fourth, $1,000, won by Count de Lambert with his Wright biplane Distance 116 kilometers (72 1 miles)

Fifth $1 000, won by Paul M Tissandier Distance, 111 kilometers (68 97 miles)

Sixth, $1,000, won by M Roger Sommer with a Farman biplane Distance, 60 kilometers (37 3 miles)

The distances covered by the other competitors were 50 kilometers (31 1 miles) by M Delagrange with a Bleriot monoplane, 40 kilometers (24 9 miles) covered by M Bleriot with one of his monoplanes, 30 kilometers (18 64 miles) covered by Mr Curtiss with his biplane, and 21 kilometers (13 04 miles) covered by M Lefebvre with his Wright machine

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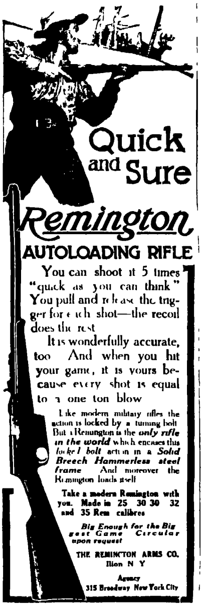

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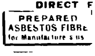

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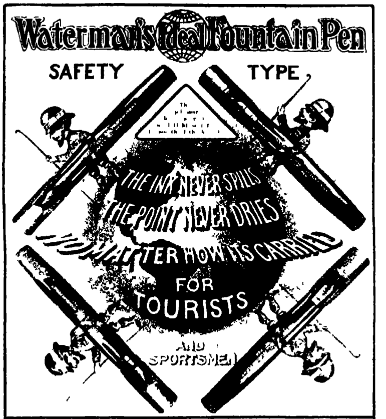

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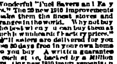

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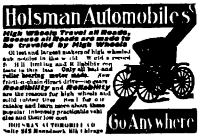

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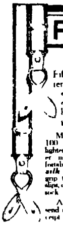

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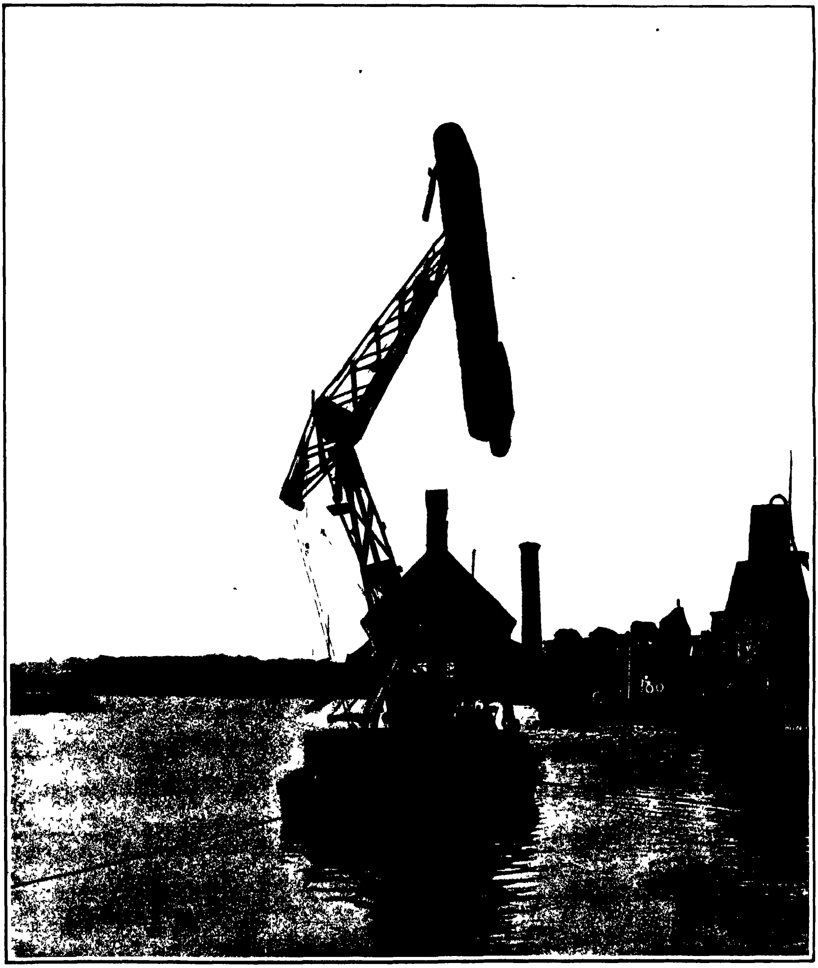

The illustration shows the height to which the elevator can be raised to go over the side of a ship.

A REMARKABLE GRAIN ELEVATOR FOR DISCHARGING VESSELS.—[See page 182.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic* the contributions will receive special attention. Accepted articles will be paid for at regular space rates

DR. COOK AND THE NORTH POLE.

To set a question mark however small against the message from Dr Cook announcing that he had reached the North Pole would be to betray a spirit of ungenerous and captious criticism The conditions of complete isolation which must necessarily surround the man who launches himself with two native helpers into that uncharted sea of eternal silence and frozen desolation are such that the waiting world to which he returns—if he ever return—must needs accept his story of a successful quest without expectation of absolute verification or disproval For the theoretical point which we call the North Pole lies as was generally supposed and as Dr Cook has now proved in a vast field of eternally drifting ice Any monument set up by the explorer at the exact axis of the earth in attestation of his crowning triumph, would be carried steadily down over the dome of the world, to be ultimately lost in the more southerly seas, or cast up, with other flotsam and jetsam, on the northerly coasts

In the interests of scientific accuracy there will of course, be a subsequent verification as far as it is practicable of the distances covered and of the observations of the sun as taken during this wonderful journey, but this investigation will not be made because of any doubt as to the actual presence of Dr Cook on the twenty first of April nineteen hundred and eight at the North Pole

The man who can look Death full in the face throughout all the cruel sufferings of a two years' search for the secret of the frozen North is built upon lines too noble to admit of the slightest subterfuge or misrepresentation, and there are certain features of Dr Cook's expedition notably the total absence of ostentation in the manner of his setting out which should at least have sealed the lips of those who have received the news of his success with outspoken incredulity

Most of the great achievements of science whether in the way of invention or discovery may be regarded as the total result of the separate efforts of individual men To some one among the many it has been reserved to win the coveted goal and have his name written forever above its portals, and he above all others realizes and is only too glad to acknowledge how greatly his success is due to the unrewarded labors of his predecessors Each unsuccessful seeker for the North Pole gathered his quota of valuable experience and the facts as thus recorded have been of priceless value to those who came after Dr Cook himself an Arctic explorer of no little experience, will be the first to acknowledge his indebtedness to that splendid band of men, beginning with Sir John Willoughby in 1553 and ending with Peary, who blazed the way for his own magnificent success.

THE TRANSATLANTIC RECORD

It has been stated and with much truth that the degree of perfection of a country's transportation facilities may be taken as a fair measure of its industrial and commercial development and from the very first it has been realized that the value of any system of transportation is dependent very largely, and in some cases primarily upon its speed Hence there has been a constant effort to obtain the highest possible speed compatible with consideration of safety and reasonable economy Because of the old-time dangers and the, to many people present-day inconveniences and discomfort of ocean travel, the attainment of high speed has been nowhere so eagerly striven after as on the great oceans which divide continent from continent, and particularly on that three-thousand-mile stretch of water which lies between the old world and the new

The contest for what has popularly come to be known as the "Blue Ribbon" of the Atlantic has always possessed a certain fascination for the public, both for those who frequently make the crossing and those who never go at all The interest dates from the days in the early forties of the last century, when the "fliers" of that time were fighting it out between themselves at a speed of ten knots, down to the present day of turbine-driven liners that can reel off their 650 knots a day at speeds of twenty-five to twenty-six knots.

When the first line of steamships to cross the Atlantic on a regular schedule of sailing was established, now some seventy years ago, it took about fourteen days to make the trip from Liverpool to Boston. The first vessel to cross in less than ten days was an American boat, the "Pacific" of the famous Collins Line which performed the feat in May, 1851 It took another twelve years to reduce the passage below nine days, the "Scotia" making the passage in eight days and three hours, in 1863 To the Inman, now the American Line, is due the credit of bringing the passage below eight days, a feat accomplished in 1869 by the "City of Brussels," in seven days, twenty-two hours, three minutes. The seven-day limit was first passed by the "Alaska" of the Guion Line, which made the trip in 1882, in six days, twenty two hours, and seven years later, in 1889 the "City of Paris" of the Inman Line now the "Paris" of the American Line, brought the record below six days, by making the crossing in five days, nineteen hours and eighteen minutes.

It was not until the advent of the steam turbine that the record was brought below five days, the "Lusitania" accomplishing this feat in 1907 by crossing to the westward in four days, nineteen hours and fifty-two minutes. In the two years that have intervened since then, changes have been made in the propellers of both boats, which have considerably increased the speed, and on her last trip, concluded on September 2nd the last named vessel, crossing at an average speed of 25 85 knots, covered the Atlantic course in four days, eleven hours, and forty-two minutes thus bringing the record for the first time below four days and a half

The question has been raised as to whether this high speed is not gained at too great a cost. For it is a fact that both the "Lusitania" and "Mauretania" burn on an average about one thousand tons of coal per day The answer is that although the aggregate consumption is large the amount of coal burned in proportion to the size of the vessel is no larger and indeed not as large as that burned by the other fast Atlantic liners of less total displacement. Thus the "Deutschland," of 23 500 tons displacement, when steaming 21 5 knots, burns about 570 tons per day which is over one-half the consumption of the "Lusitania," whose displacement is nearly double that of the "Deutschland," and whose sustained sea speed is about two and a half knots greater Moreover, there is a large and ever increasing number of people who, either for business reasons or because of a dislike of ocean traveling, are perfectly willing to pay the higher rates which are necessary to make these high-speed vessels pay Furthermore, the advantage in the acceleration of mail service alone, is probably in itself sufficient justification for cutting down the time of transit between New York and London by twenty hours, as compared with other routes. For the adoption of Fishguard, on the west coast of Wales, as a port of call, and the installation of a service of fast steamer trains between that port and London, made it possible for the mails and passengers, on the last trip of the "Mauretania," to leave New York at 10 A M on Wednesday and reach London at twenty minutes past 7 on the following Wednesday evening

As to the possibilities of the future, it can safely be predicted that the question of bringing the transatlantic record below four days, is one of finding some new form of motive power It will never be accomplished by the turbine-driven ship. Whether the producer-gas engine can be developed to a point of compactness and efficiency that will enable it to perform the feat, is a question which the future must decide

ECONOMIC LOSS OF OVERCROWDING.

That the present overcrowding in the congested and poorer districts of our cities is to be condemned on humanitarian grounds goes without saying. The suffering which results therefrom, the multiplied miseries, not merely of the poor, but of a considerable section of the artisan class, of the tenement districts forms one of the most tragical phases of modern city life All of us who have given any thought to the matter, are convinced of this; but it is reserved for the social economist to show that the discomfort, suffering, and death directly resultant from overcrowding represent also a great annual monetary loss.

The method of stating the evil results of disease and accidents in dollars and cents has come into vogue of late years, and although the practice has been made the subject of some criticism and ridicule we consider it is justified on sound economic grounds A recent analysis of this character is the statement issued by the Committee on the Congestion of Population, which estimates that the annual economic waste in this city from certain preventable diseases has reached the high figure of between $37,000,000 and $41,000,000. This estimate is based on the loss of time of the wage earners through illness and death, which are traceable largely to congestion of population. The Health Department has made the following classification of preventable diseases: Typhoid fever, pneumonia, broncho-pneumonia, diphtheria, smallpox, cerebro-spinal meningitis, diphtheria and croup, measles, scarlet fever, whooping cough, diarrheal diseases, tuberculosis pulmonalis. The committee argues that if the above diseases are preventable, and the economic waste of the community in the way of loss of wages, etc., amounts to $40,000,000 a year, it would be the part of wisdom to make a more careful study of the predisposing conditions, and particularly of means to prevent overcrowding

In arriving at the above estimate, it is considered that the prospective earnings when death occurs between the ages of 20 and 62 have an average value of $2,000 for men and of $1,000 for women For the four years from 1905 to 1908, it is estimated on the above basis that the waste from death, due to certain preventable diseases in New York, may be conservatively estimated at over $95,000,000, and that the economic waste from sickness due to these same diseases may be placed at over $71 000,000, making a total economic loss of over $166,000,000.

THE ELIMINATION OF GRADE CROSSINGS.

Although the advent of the automobile has attracted public attention in a most tragical manner to the peril of railroad grade crossings, the loss of life among the users of automobiles represents only a certain proportion of the annual number of fatalities due to this cause. The time will come when our increasing regard for the sanctity of human life will lead, either to a total abolition of crossings at grades, or to such an ample protection as will place the responsibility for accidents of this character almost entirely upon the highway traffic, whether pedestrian or vehicular

There are at the present time in New York 10,544 points at which railroad tracks encounter public highways, and at 1,698 of these points the crossings at grade have been removed The protected crossings number altogether 3 676, distributed among the different railroads according to the following percentages Long Island Railroad, 51, New York Central, 43, Delaware, Lackawanna & Western, 42, Erie, 31, Delaware & Hudson, 30, New York, Ontario & Western, 30, Lehigh Valley, 20

During the last five years the different railroads, with the assistance of the State and municipalities, have been actively engaged in reducing the number of grade crossings on their lines by either elevating or depressing the tracks. These grade crossings have been reduced in certain percentages of the total from 22 on the Long Island Railroad down to 10 on the Delaware & Hudson Railroad

The work outlined by the Long Island Railroad Company includes the removal of 14 grade crossings on the line to Manhattan Beach, 45 grade crossings on the Bay Ridge line, the elimination of some very dangerous crossings on 14 streets by the construction of a tunnel under East New York Hill, and the removal of some 203 grade crossings in Queensboro During the last Legislature a bill authorizing the city to share the expense of removing these last-named crossings failed of passage, indeed, for the first time in many years, the Legislature at its last session failed to make any appropriation for continuing the work of grade crossing removal in this State. Up to the present time the Long Island Railroad has spent $12 500,000 in improvements involving grade-crossing elimination, while the city's share in the improvements involved the expenditure of $3,750,000 The company is prepared to spend an additional $8,000,000 in getting rid of the 203 crossings at grade which still remain in Queensboro, provided the city would continue its former policy of contributing one-half of the expense.

In view of the fact that grade-crossing removal not merely eliminates a most serious menace to public safety, but that the elevation of the tracks results in a quickening and all-round improvement of the train service, it would seem that there are very good reasons why the Legislature should enable the city to continue its former policy of contributing to a work which may be justly considered as a public improvement. The city, of course, should never have allowed the tracks to be laid through the streets at grade in the first instance. On the other hand, a large proportion of the mileage, now lying within city limits, was surrounded by open country when the rails were first laid.

ENGINEERING.

What is claimed to be the record torpedo shot of our navy was made during the recent maneuvers of the Atlantic fleet off Provincetown, when the submarine "Cuttlefish," selecting the battleship "Vermont" for attack, fired a torpedo at a range of 3,800 yards, hitting the "Vermont" squarely amidship.

A gas-driven street car is now under construction in Philadelphia, which is to be tested on the line of the Metropolitan Street Railway Company of New York in competition with the electric cars of the company It will be driven by two 4-cylinder motors, each of 24 horse-power These will be water-cooled, and piping will be led from the motor jackets around the interior of the car to heat the latter during winter service.

The fast steam yacht "Winchester," which is now being built by Yarrow will attract considerable attention because of the up-to-date character of her motive power Steam will be supplied by water-tube boilers fired exclusively with oil fuel, and the yacht will be driven by Parsons turbines of 3 400 horse-power operating three single-propeller shafts. The vessel, which is of 180 tons, is 165 feet long, 15 feet 6 inches beam and 9 feet 9 inches deep

The French battleship 'Iena," which a few years ago was wrecked by an explosion of the smokeless powder in her magazines is being used as a target and several important problems are to be determined relating to the effect of shell fire. Recently after caged animals had been placed on board the ship, she was attacked by the cruiser "Latouche Trouville" with high-explosive shells. The deadly effect of the gases of the explosion was shown by the asphyxiation of several of the animals.

There is no doubt that one cause of the objection to motor cars on the part of a certain section of the public is the use of headlights of dazzling brilliancy The Technical Committee of the Royal Automobile Club are making experiments with a view to finding a lantern which will give sufficient light for vision, but will at the same time be so controlled as not to dazzle the drivers of approaching vehicles or pedestrians. The tests are being made with acetylene petroleum and electric lamps.

Last week we made note of the retirement of two famous record holders, the "Umbria' and 'Etruria,' from the Atlantic service. It is now announced that the "Lucania," which was recently burned at her pier in Liverpool will not be repaired, but will go into the hands of the underwriters She was the first vessel to make the transatlantic trip at over 22 knots an hour Her place will be taken by a new turbine 21 knot ship of 35,000 tons.

The work of installing the roadbed rails, and operating equipment of the recently completed D tube of the Pennsylvania tunnels below the East River, was begun in Long Island City last week Of the four tubes, the two inner tubes, known as B and C, are nearing completion and all four can be finished and in readiness for operation between Long Island City and the Pennsylvania Terminal on Manhattan Island by the first of next year.

The Cleveland Industrial Exposition, which we recently had the pleasure of visiting has been successful beyond the expectation of the Chamber of Commerce, which is responsible for its promotion The exhibits were more numerous and of a higher character than was anticipated, and the attendance has run up to as high as 30 000 daily It looks as though the huge national exposition, which as in the case of the St. Louis Fair had grown to an altogether unwieldy size, will in the future be replaced by local expositions held in the larger cities.

Everyone who is familiar with the valuable historical collection of scientific appliances now at South Kensington, London, will regret to learn that "at present these treasures are huddled together in makeshift buildings quite unsuitable for the purpose of a museum" The commissioners of the great exhibition of 1851 offered $500,000 and a suitable site for a properly equipped science museum provided the government would undertake to maintain it. A delegation representing all the scientific interests in Great Britain have urged the government to give their immediate attention to the proper housing of this collection.

The grand total of excavation on the Panama Canal during the month of July was 2,842,360 cubic yards, which is 53,533 cubic yards less than the total for June, and 1,037,077 less than the highest record, made during the dry season in March of the present year Of the amount removed from the canal prism, 1,684,663 yards were taken out by steam shovels, and 1 107,814 yards by dredges. The mean rainfall was 10.64 inches for the month, in which there were twenty-six working days. Incidentally it may be mentioned that the Tariff Act, approved by the President August 5th, authorizes a bond issue of $290,569,000, in addition to the $84,631,980 heretofore issued for canal construction.

ELECTRICITY.

During the recent rioting at Barcelona, all the gas and electric-light plants were out of commission, and the city was illuminated only by the searchlights of warships in the harbor

At the annual convention of the Association of Edison Illuminating Companies, the licensees under Mr Edison's patents, held last week at Scarborough on the Hudson, was celebrated the thirtieth birthday of the incandescent lamp

In order to compete more effectively with the gas company which lets kitchen and other stoves the municipal electric light plant of Aberdeen, Scotland has laid in a stock of electric heating and cooking apparatus, which it proposes to offer for hire at proportionately low rates

An electrical exhibition will be held in Boston from the 15th to the 25th of November at which all the latest labor-saving and comfort-giving devices will be exhibited, with elaborate and novel decorating and lighting effects. Prizes will be awarded for the inventions and ideas of amateurs, and space set aside for the exhibits of amateur wireless operators

Our allusion last week to a power shovel as an unlikely machine to be successfully electrically driven has caused our attention to be drawn to an electric well-drilling machine produced by the Keystone Driller Company of Beaver Falls Pa and successfully operated near Chicago From the very wide range of its operations, often remote from habitation let alone power plants, the driller certainly seems an even less likely machine to be operated electrically than the shovel, but the supply has doubtless been created by a demand and in districts where prospecting or other drilling is carried on within reach of electric wires, the machine should have great advantages.

The Montreal Light Heat and Power Company has announced that it will engage in the ice business obtaining water from artesian wells and freezing it by electric power into blocks of any desired shape and size so as to avoid cutting This is an example which might with advantage be followed by many a smaller plant. Every lighting plant must be capable of carrying a certain maximum load at the time of night when most lights are in use but for at least 18 hours out of the 24 the load is from half as much in large cities to almost nothing in small country places where there is little industrial use of electrical power so that during the greater part of the day much of the capital invested is earning no dividends The surplus power might just as well be used in making ice and providing another source of revenue, particularly as the time when the peak load is of shortest duration coincides naturally with that of the largest consumption of ice.

Remarkable results have been obtained by an electrical ozone-generating apparatus recently installed at the public library on Michigan Avenue and Washington Street, Chicago It appears that complaints had constantly been made of the unpleasant odor from accumulated human emanations and this in spite of an excellent purified-air ventilation system the nuisance becoming such that an attempt had to be made to counteract it. Direct current at 110 volts is converted to alternating at 120 by a rotary converter and the latter stepped up to 8 000 volts by a transformer This high tension secondary current discharges between the plates of the ozoniser through which is drawn the air led to the ventilating apparatus above Enough oxygen is converted to free ozone to kill any living organisms in the air and neutralize any kind of odor The most remarkable result of the installation appears to be the substitution for unpleasant if not actively unwholesome air of an atmosphere actively healthful

The Electrical Review suggests that trackless trolleys," such as are successfully used in Austria and elsewhere in Europe that is to say, electric vehicles running on ordinary roads, but taking power from overhead wires might be advantageously used to take the place of horse-drawn stage coaches which still connect with the railroads numerous villages having no other means of transportation even in the most populous parts of the country It is pointed out that such stage lines rarely have a traffic which would encourage the projection of electric railroads to take their place as a profitable venture but figures are quoted to show that of the cost of roadbed track, and electric-line construction in electric railroads, only 15 per cent or less is for overhead conductors and poles, considering therefore that electric road vehicles are obtainable for a much lower cost than railway cars, and that the power-generating plant would be so much less for a little line operating only three or four stages back and forth per day, it is obvious that such a trackless trolley system could be undertaken for a tenth of the cost of an electric railway, and with a much better chance of profitable operation.

SCIENCE.

Plans have been filed for a new home for the American Geographical Society at 156th Street and Broadway The building will form one of a group that now includes the Hispaño Society's home and the Numismatic Museum although it has no connection with either institution The building will be erected from funds provided by Mrs C P Huntington The estimated cost of the building will be between $250 000 and $300 000

Prof. Charles Richet of Paris has devised a means for purifying the air in rooms According to press dispatches, his apparatus is an air filter which mechanically sterilizes air Very fine drops of glycerine are scattered along the walls of a cylinder containing a suction fan Each particle of air drawn in by the fan is freighted with glycerine and hence tends to drop thereby carrying with it the germs dust and microbes with which it may be laden

The peculiar odor of clay is unquestionably due to organic ingredients Although these cannot be isolated or detected by chemical analysis they can be classified according to their physiological effects which vary widely Rohland has succeeded in transferring the odors of clay to saccharate of iron and has thus recognized ten distinct varieties Louis has made similar observations employing ammonia as a vehicle for the odors

Charles S. Philipp has produced a variety of glass which is a good conductor of electricity by fusing together 32 parts of sodium silicate, 5 parts of borax 0 8 part of lead oxide and 0 2 part of sodium antimoniate The glass is not attacked by acids Its electrical resistance is about 1 000 times smaller than that of ordinary glass It is used chiefly for the disks of electrometers and electroscopes Filaments of the new glass may even be substituted for the gold leaves of an electroscope

A human hair of average thickness can support a load of 6¼ ounces and the average number of hairs on the head is about 10 000 A woman's long hair has a total tensile strength of more than five tons and this strength can be increased one-third by twisting the hair The ancients made practical use of the strength of human hair The cords of the Roman catapults were made of the hair of slaves and it is recorded that the free women of Carthage offered their luxuriant tresses for the same use when their city was besieged by the Romans.

In the early part of the present year the French Academy of Sciences discussed a communication in which it was asserted that the human body emits radiations which affect photographic plates In the course of the discussion De Fontenay demonstrated that the effects which had been attributed to radiations could be explained perfectly by the warmth and moisture of the body Later an attempt was made to sustain the theory of human radiations by the statement that the Lumière company had been compelled to discharge several employees who fogged the plates that passed through their hands De Fontenay investigated the matter and found that nothing of the kind had ever occurred at the Lumière factory Every case of fog was due to accident and to well known causes—finger marks packing strips lantern fog etc not to any mysterious human radiation In regard to animal magnetism unknown natural forces and other occult agencies it is bad enough to be assailed with crude experiments and unproved assumptions without the aid of false testimony Legends of this sort are easily propagated and hard to kill Ten years hence the alleged experience of the Lyons plate makers will doubtless be still adduced as a proof of human radioactivity

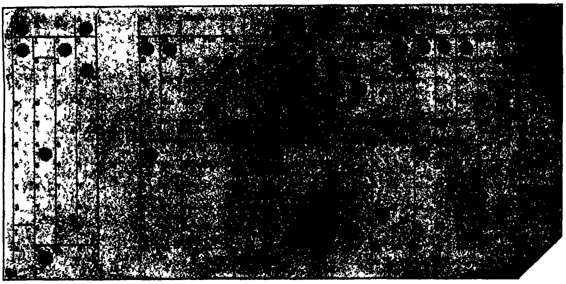
A. Kuerth has obtained the following results in a series of experiments on the effect of heating on the hardness of various metals A bar of very uniform copper was cut into five pieces 2½ inches long and 8/10 inch broad In the cold all pieces showed exactly the same hardness. They were heated in oil or saltpeter baths to temperatures of 300 570 660 700 and 840 deg F respectively for from one to thirty minutes and allowed to cool the hardness in each case being determined at the temperature of about 70 deg F The specimen heated to 300 deg F showed a hardness which was almost independent of the duration of heating, the coefficient of resistance being eighty kilogrammes per square millimeter but in other cases very great variations were observed With the bar heated to 840 deg F the value of the coefficient fell in one minute to 40 and thereafter remained almost constant at 37 Other experiments were made with specimens of nearly pure nickel aluminium zinc and tin, and with various Krupp steels The temperatures used ranged from —116 deg F to 900 deg F In general the hardness of steel decreased as the temperature rose up to about 300 deg. F at which point there was a slight increase in hardness, which was followed by a diminution as the temperature was raised still higher

COUNTING OUR PEOPLE BY MACHINE.

BY H. HAMILTON TALBOT

The counting at the end of each decade of every man, woman and child in the United States is one of the biggest undertakings the government is called upon to assume To facilitate counting, machines will be used invented by Mr James Powers, a mechanical expert of the Census Bureau, for use in the thirteenth census which were successfully tried in the recent Cuban census, and now in use in the Division of Vital Statistics of the Census Office.

The mechanical method for counting the census requires two types of machines, which are of equal importance, and each essential to the successful use of the other The keynote of the system, however, is a punched card which contains the data collected by the enumerators, who travel from house to house in *every nook and corner* of the land The data include the nature and extent of our industries the amount of our wealth etc By means of the punched card a tabulating machine mechanically classifies the data thus sent in to the Census Office by the enumerators The location of the holes on the cards means everything to the tabulating machine as will be seen later, for the special position of a hole within the limits of certain boundary lines on the cards means one thing and in another position another thing It is this location of a punched hole on a card that enables the tabulating machine to transfer the value of that particular position of a hole on a card to a number of counters, which classify the data and obtain totals



One of the punched cards.

The punching machine which was used in the eleventh census, and again with improvements at the twelfth census, was a rather simple affair, in which the pressure of a lever by hand was necessary for the punching of each and every individual hole The machine recently invented for punching bears no resemblance to the old apparatus and is run by electricity instead of hand power

The new machine is built on the plan of a typewriter with 240 keys. The operator instead of punching one hole at a time presses as many keys as may be necessary After all the facts have thus been recorded by the keys a bar resembling that of a space bar on a typewriter is pressed, which brings an electric motor into play whereupon all the holes are punched at once without any effort on the part of the operator The average number of cards punched per day at the Census Office with the hand puncher was 900 while with the new machine a speed of 4,000 cards per day is attained In the old punching machine a hole was punched in a card every time a key was depressed If an error was made the card had to be thrown away thus wasting not only the cards but the operator's time In the new machine each key is depressed independently of the others and can be released at will without punching a hole or recording a fact until the operator is ready to press the motor bar, which punches all the holes at once. Before the operator punches any holes the operator can look over the depressed keys and ascertain whether all are correct. If an error be discovered, the wrong key can be released and the error rectified before any punching is done The color of the keys for each field of the card is different, which enables the operator at a glance to locate the keys representing the different fields of information. The cards are fed to the machine from the back by electricity

To make this method clearer, study the accompanying picture of a card, which is now in use in the Vital Statistics Division of the Census Office and which is representative of all cards used in their new punching machine, a change in the symbol keys of the machine making it available for population work.

The holes are divided into two classes by the vertical lines on the left-hand side of the card The first class aided by the large numerals at the right hand edge, identifies the person, and enables the census expert to find immediately the original entry from which the card was made, the second class gives all the statistical information regarding the person for whom the card was made. For instance, the *W* means that this person was white, the *M* means that the person was a male, the *Dec* that he died in December, the 20 and 4 that he was 24 years old, the *Sg* that he was single, the *US* in the next three fields that he was born in the United States, as were both his parents. The two fields immediately below show his occupation at time of death and also the cause of death A similar card is being made in the Census Office for each death reported in the United States, and one will be punched for the many million inhabitants reported by the enumerators in the forthcoming census

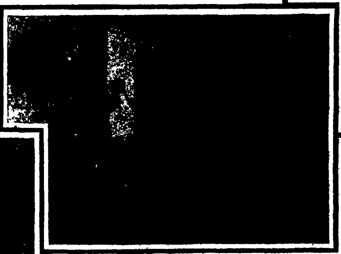
In connection with the invention of this new machine, it is interesting to note that it will render it possible to announce the total population at the next decennial enumeration in record-breaking time; for automatic counters are attached to the keys, and register on a dial every time a hole is punched. Thus, just as soon as the 90,000,000 cards (more or less) representing the people of the country have been punched, the Census Office will be enabled to announce immediately the totals as to the different classes of our population—males, females, natives, foreigners, white, colored, married, and single. Under the old system, when all the punching was done by hand, these figures were not available until the tabulating work was started.

After the transfer of information to the cards has been completed, the schedules from which the information is derived are filed among the government records, and all the work of statistical tabulation is done with these cards. One notices that the clerks working on them cannot tell the names or addresses of the individuals for whom the cards stand, and that thus in the presentation of census tables the personal element is entirely lost.

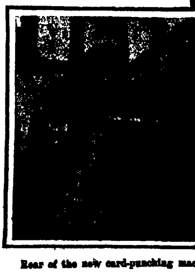
After the cards have been put through the punching machine, they are ready for the tabulating machines. The operator puts the cards, one at a time with her right hand, into a box with a multiplicity of little spring-seated pins above the card and a corresponding series of mercury cups below it. As she moves her hand from the machine to pick up another card she touches a spring on the lower edge of the pin box, which brings an electric motor into play The pins which are in line with the holes of the second class on the card descend through the holes, and by *touching* the mercury below make so many electric contacts. Each pin and its mercury cup are terminals of a separate current passing through an electro-magnet controlling a counter or dial Thus, referring again to the card, the current entering the field for *Col*, or *Color*, would have five possible paths. The routes diverge at the five points where holes in the cards might have been. Of these five routes four are closed by the surface of the card, and the current is compelled to go by the fifth, where the hole has been made, and is guided to the dial for *Color*, and so on in each field. These dials contain the various combinations of statistical information, from which the tables as finally set forth in the census volumes are made.

An automatic recording and printing system—on the plan of the familiar stock ticker—is connected with each dial. When the operator wishes to make a reading of the dials a button is pressed, with the left hand, and the figures on the dials are printed on the ticker paper, from which they can be read. The dials are automatically reset. In the machines used in former census work the dials had to be read and the results recorded by hand—a proceeding productive of many errors—and then all the dials had to be reset by hand, a time-consuming operation The daily output of the old machines averaged 18,000 cards, while the new machines are counting 28,000 cards per day.

Front view of the card-punching machine.



The new tabulating machine.



Rear of the new card-punching machine.

COUNTING OUR POPULATION BY MACHINE.

Photographs copyright 1909 by Waldon Fawcett.

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An occultation of Mars occurred on September 1st, which was observed by many astronomers, although the event is not of much scientific importance.

HOW SUDD CHOKES THE NILE RIVER.

BY DAY ALLEN WILLEY.

The actual head of navigation of the Nile River is considered as at the town of Gondokoro, for the reason that the depth of water is sufficient to float a steamer to the famous city of Khartoum, a distance of 1,081 miles to the northward. South of Gondokoro are stretches of water available for light-draft boats, but the interruptions to navigation are so numerous that this portion is not considered a practical route for water traffic. When Mr Roosevelt concludes his African hunt at the banks of the Nile, his expedition will take a special steamer at Gondokoro and attempt to reach Khartoum by water The word "attempt" can be appropriately used, for the reason that the channel may be blocked by sudd in the river to such an extent that the party must go overland for some distance if they would reach Khartoum at the date expected

Just how the word "sudd" originated is a mystery but every Egyptian traveler knows perhaps too well what it is, for many a time this vegetation has choked the upper Nile to such an extent that boats have been held weeks at a time until a way could be cut, burned, and pulled through it So dense, so thick, is the water growth, that if allowed to continue, it forms a literal mat over the channel, so compact and so strong that such animals as the elephant, even the hippopotamus, have been seen to go across it, and without breaking through the matted roots, branches, and leaves In short, the rapidity with which the sudd spreads over the water, and its parts interlace, is such that in a few weeks a space of the Nile once clear of it will be completely hidden by a mass of waving papyrus but underneath is a combination of water plants that attach themselves to the papyrus stalks, and form what is literally a cover of vegetation, through which not a foot of the river may be visible

Section of upper Nile, showing channel nearly filled with sudd.

Detail view of water papyrus or sudd.

In all of the thousand and odd miles from Gondokoro to Khartoum, and even above Gondokoro, does this water growth flourish, and consequently the engineers of the Egyptian government have no small task to keep open a channel for the steamer service. Although but one boat monthly plies regularly between the places mentioned, there is considerable tourist and other traffic near Khartoum, and a fleet of craft are in service to remove this curious growth. To clear a channel even large enough to admit the smaller type of vessel is not an easy task, since the sudd is so dense and so difficult to pull out—the usual way of getting rid of it. Where the Nile is wide and the water of sufficient depth, the vegetation is left untouched unless it entirely closes the channel, so a boat may make a detour of several miles out of the ordinary course, skirting one of the strange floating islands. In fact, the growth along the upper Nile is so enormous that patches of it skirting the shore may be seen for distances of a hundred miles without a break or gap to the land itself. Islands of the stuff a half dozen miles in area are sometimes carried down in the Nile flood current until they lodge against a projection of the shore or ground in shallow water Thus it is that new "islands" of it are created often far downstream from the region where the sudd is most abundant.

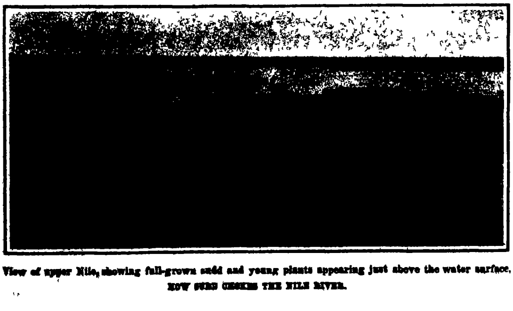
In clearing the river channel of sudd the engineers have devised several schemes. The top growth frequently becomes so dry that they can burn it over like so much grass. This removes much of the weight of the plants, but they are so matted together, that saws are actually used to separate the growth, as it cannot be removed in any other way The vessels employed for sudd clearing, while light-draft boats, are strongly built and have blunt bows so that they can be forced against the bank of vegetation They are provided with steel cables or hawsers saws, and axes, and carry crews of natives who are experts in working upon the sudd.

The way in which the channel is cleared is as follows Often the water is so completely hidden that the first difficulty when you are encountered by a barrier of sudd, is to discover where in this sudd the river bed runs. This is done by a method of "sounding" through the sudd The average depth of water in the sudd may be only a few feet, but when the true river bed is reached this suddenly increases to a depth of 15 to 18 or 20 feet. Having found the real river bed, the first thing to do is to cut down or burn the top growth *consisting mostly of papyrus*. A curious and unexplained fact noted by the engineers is that when papyrus is fired, the flame frequently spreads along what is afterward discovered to be the true bed of the river

Having cleared the top of the sudd "block" the men are landed with large saws to cut along the true river bank, which may be either submerged with a few feet of water over it and papyrus and sudd on it, or solid ground with ant heaps the solid ground never being of any great extent and always surrounded by swamp Cross and parallel cuts with the saws are then made through the sudd dividing it into blocks of a convenient size for the steamer to tear out the size of these blocks of course depending on the consistency of the sudd and the power of the steamer

Having cut the sudd into convenient blocks the bow of the steamer is run into the block the loop of steel hawser both ends of which are made fast to the steamer, is passed over the bows of the steamer where it is taken by the men on board and placed in what is called the trench cut and held down with their feet. The steamer then goes full speed astern the men all standing on the hawser to keep it in position In the case of tough sudd as many as twenty trials may have to be made in this way before the block of sudd eventually tears away In the case of shallow light sudd the hawser may be trodden down too deep and slip underneath, in which case the block will be cut free but has to be again gripped by the hawser and towed away When the block is torn out the steamer goes slowly astern till the mass is pulled clear into the current—if there is one—when it is cast adrift to float downstream where it is gradually disintegrated If there is no current it is towed to a piece of open water where as a temporary measure it can be tied by ropes to the bank leaving a wide enough channel for the steamer and on the appearance of a current, be cut adrift to float downstream

The chief growths in the sudd are papyrus and tiger or elephant grass a kind of bamboo growing to a height of 20 feet or more To these climbs a creeper of a kind of convolvulus. Another portion of the sudd consists of ambatch and a long sword grass that cuts like a knife known as oom soof The steamer could cut its own way through this latter which in the presence of a current would be broken up and float downstream offering no obstruction In calm water, however it does not float away but ob-



View of upper Nile, showing full-grown sudd and young plants appearing just above the water surface.

HOW SUDD CHOKES THE NILE RIVER.

structs the steamer by constantly fouling the paddle-wheel There is another very light kind of duckweed which covers some of the small open pools, and in the absence of a current is a great nuisance for the same reason

Strange as it may seem, the sudd interferes but little with the flow of the river, and the Nile passes under it with little resistance This is because the growth is principally near or on the surface As the river is over a mile wide in some places, and the deep channel may be only a hundred feet, it is often hard to tell where to find the channel to clear it, as all of the water may be hidden Men with long poles push them through the sudd to the water and by this method of sounding locate the channel, when the sudd clearers get into operation

The water papyrus plant so often seen in the sudd has given rise to the theory that the growth is composed of papyrus but an analysis by naturalists shows that there are four vegetable elements that are the principal creations of this strange natural bridge They are known scientifically as the *Papyrus cyperus* the *Panicum pyramidale* the *Phragmites communis*, and the *Typha australis* They form the framework of the mass but interlaced with them as stated, are several species of twining and climbing plants that greatly strengthen this strange fabric It may as already stated support even the weight of an elephant where it is thick enough The papyrus with its wide top covers the sudd and thus gives the idea that it is the only obstacle when as a matter of fact this is a great water carpet woven as deftly and strongly as if by the loom

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The Highest Flight of a Balloon.

The unprecedented elevation of 95 250 feet or 18 miles was attained by an unmanned registering balloon which was recently released at the Belgian meteorological institute at Uccle At this elevation the barometric pressure is only 2/5 inch The greatest height ever attained by a manned balloon is about 6 7 miles or 35 400 feet The Berlin aeronauts Berson and Suering who established this record were unconscious when they reached the highest point of their flight

The Belgians adopted Hergesell's plan of attaching the instruments to a small and partially inflated balloon suspended from a larger and fully inflated one The large balloon rises until it bursts and the small balloon falls slowly so that it can be easily observed and brings the instruments safely to earth At the maximum elevation 18 miles the thermometer recorded a temperature of —82 deg F but a lower temperature -88½ deg F was registered at the comparatively small elevation of 8 miles These observations appear to support the hypothesis that some of the ultra red solar radiation is absorbed by the higher strata of the atmosphere but additional observations will be required to solve the question

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The Current Supplement

What is probably the very highest branch of the molder's art is the casting of bronze figures and statues The opening article of the current SUPPLEMENT No 1758 discusses this art most thoroughly The ultramicroscope and ultramicroscopic objects are discussed in simple language Charles Engel tells something of the economy of cold in modern life Of the many problems that confront the American housewife the subject of vegetables for her table during the winter months is not the least important How that problem can be solved is told by J F Breazeale in an article entitled Canning Vegetables in the Home' Prof F H Starling points out the lesson of evolution The importance of ferments in organic life is dwelt upon by Dr A Zart Sir Andrew Noble recently read a paper before the Institution of Engineers and Shipbuilders on the history of propellants That paper is reprinted in the current SUPPLEMENT The Aerial Propeller Its Form and Construction is the title of an article by Lucien Fournier Sir J J Thomson's brilliant paper on recent studies of electricity and matter is concluded

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An epidemic disease known as the white' of oak has been studied recently by Griffon and Maublanc It prevailed in France especially during 1908 The disease is properly called oidium and it is not confined to the oak but also attacks the ash elm and chestnut It is also found in Algeria The disease is supposed to be due to a micro organism known as *Microsphera alni* The question as to whether it is indigenous or not has not been determined It increased in France during 1907 and 1908 in an unusual way Should we suppose it to be imported like black rot or mildew this would appear bad for the future while if it is indigenous it is likely to disappear again Some persons advocate a treatment with sulphur but others claim that this has no effect One important point in any case is the time of the year when the treatment is made

Correspondence.

THE NUMBER OF OUR ANCESTORS.

To the Editor of the SCIENTIFIC AMERICAN

If it is not too late, I would like to add a few words to the correspondence which appeared recently in the SCIENTIFIC AMERICAN concerning the number of our ancestors.

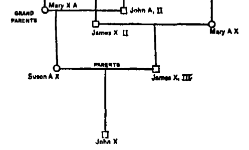
Your first correspondent, Mr A. K. Venning, comes to the conclusion that long before the 5,000 or 6,000 years of authentic history is reached, the number of our ancestors would be so large that there would not be standing room for them on the face of the earth, while your second correspondent, Mr Ernest McCullough is inclined to ridicule this, and thinks that the figuring is more apt to work the other way Permit me to offer the following explanation The explanation lies in the difference in the ages of our ancestors. There is usually a considerable divergence in the ages of our grandparents, and going back farther, the difference in age increases with each generation, so that by the time the fifth or sixth generation back is reached, some of our ancestors would be new born babes while others would be in their graves. It is readily understood from this that the number of our ancestors is just as liable to decrease with each generation owing to the ravages of the grim reaper Death as to increase If our grandparents were all born the same year, all married the same year, and both couples had children the same year Mr Venning's conclusions would be correct, provided no one ever died When I say grandparents in this case, I mean all our ancestors indiscriminately

East Canaan Conn DEWEY C CANFIELD

To the Editor of the SCIENTIFIC AMERICAN

I notice in one of your recent issues a communication from Mr Venning of Los Angeles, Cal in which he seeks a solution of the puzzling question of accounting for the discrepancy between the apparent number of a man's ancestors as given by the rules of geometrical progression and the lesser number which experience shows to be the case I think the solution is to be found in the simple fact that our ancestors have been in the habit of intermarrying with their cousins sometimes this relationship being near and sometimes more distant. Otherwise we would inevitably enjoy our allotted number of 2^n ancestors for any given generation Thus one set of one's great grandparents on the maternal side are often one's great parents on the paternal side also For instance a man whose ancestors for two generations had intermarried with their first cousins would have the lamentable misfortune of possessing but four great grandparents as shown by the inclosed diagram, when by all the rights of arithmetic he should have sixteen to be proud of Of course this relationship is often so far removed that it is impossible to trace it, but each time one's parents have a common set of ancestors no matter how far removed, it is evident he is being deprived of his allotted share of ancestors to that extent at least, and it might be mentioned it would be next to impossible to find any two Englishmen to-day who had not in common an innumerable number of ancestors. F W A

Knoxville, Tenn



To the Editor of the SCIENTIFIC AMERICAN

Publication of this problem has not as yet brought any solution, but it has cleared the air to some extent, I am glad to see May I point out to Mr King that the question of relationship of descendants has not really anything whatever to do with the answer? He is leading the hunt off on a false scent. If we leave out of consideration altogether the present inhabitants of the earth, and start from the premise that there is only one person alive to-day—say Mr. Constable's John Brown—the problem remains unaltered, only being thrown back a few centuries.

The [illegible] John Brown has [illegible] ancestors, then it is only a question of time—of a few thousand years—for the number then alive to be so great that there would not be standing room for them upon the globe. The existence of 1,500 million or so of other persons, and those, moreover, composed of different races, to say nothing of the vast animal life, only adds to the mystery If we limit the inquiry so as to bring it more clearly within the focus of human understanding, say to 1,000 years, we find that one single Englishman alive to-day had, at the time of Alfred the Great, 1,094 millions of progenitors living at that time, as mentioned in my original letter

Five hundred years gives a proportionally similar result, as incomprehensible and puzzling.

Los Angeles, Cal. A. K. VENNING.

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THE RECENT CURIOUS ECLIPSE OF THE SUN.

To the Editor of the SCIENTIFIC AMERICAN

The recent eclipse of the sun was both annular and total, an anomaly which becomes intelligible if we consider the data given in the American Ephemeris and Nautical Almanac for 1909, under the head of Eclipses and Phenomena Accompanying the Same." The interesting phenomenon was not caused *per se* by the varying distance of the moon, which could not be possible, but by the varying distances on the earth where the moon's shadow or better where the shadow caused by the moon reached the earth's surface. Let me say that the phenomenon is a rare one and can occur only when the sun, moon and earth are so situated that the moon's position with relation to the other two bodies gives it such an angular diameter that the nearest point of contact of its shadow on the earth will just cover the sun's disk, thus giving us a total eclipse This condition we might call a critical one, for should that distance be increased by a few hundred miles between the moon and the point of contact of its shadow on the earth, there would be an apparent decrease in the angular diameter of the moon's disk thus allowing an annulus of light from the sun to pass over its edge, and thus producing an annular eclipse

Now this is just what happened in the last eclipse. The first annular phase was about the latitude of Tomsk in Siberian Russia in the early morning, and as the solar rays had a large angle of inclination, they had to travel much farther before they reached the earth than when the sun was in the meridian at midday

The same conditions were present when the sun was low in the western horizon, i. e, the solar rays reached the earth's surface at a low inclination, thus repeating the annular phase on the west coast of Greenland in the evening.

Just at what points on the earth's surface the total phase commenced and ended, I am uncertain I do not believe that the points have been worked out, owing to the fact that the duration of the eclipse at any one place would be so short that astronomers did not deem it worth while to consider it as of enough value to send an expedition, even should it have been in an accessible part of the world As the total phase was likely all within the Arctic Circle it goes without saying it wasn't worth while Data are given in the American Ephemeris by which the problem can be solved for any part of the path of the eclipse

I made a search through Grant's "History of Astronomy" and found no similar eclipse noted, but Dr Schlesinger, director of our observatory at Allegheny, tells me that it may occur once in about a hundred years. Yet when we think of the many anomalous motions of the moon we cannot but have the most profound respect for the mathematical astronomer who can sift out from the intricacies of these anomalies such a marvelous solution of the problem of eclipses as noted above.

I trust this note will be of some use to my old-time friends of the SCIENTIFIC AMERICAN Too often my humble contributions on astronomical subjects are sadly distorted, and before they have traveled the rounds of newspaperdom have been made sensational, to my regret, but I am always content if I have added only a little to the sum of human knowledge and human happiness. JOHN A. BRASHEAR,

Beaumaris, Ont, Canada.

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The stirring of chemicals in the solution tanks of the Oberlin, Ohio, water softening plant, states the Engineering Record, is accomplished by the use of power furnished by a Pelton water wheel. The wheel is 12 inches in diameter, operates under a pressure of from 9 pounds to 22 pounds per square inch, and consumes about 50 gallons of water per minute. The wheel drives a main shaft, which drives the stirrers, or revolving arms, through the medium of a belt. The waste water from the water wheel is used for preparing the lime solution. The speed of the [illegible] revolutions per minute, of the lime [illegible] revolutions per minute; and of the [illegible] revolutions per minute.

THE SEVEN BRIDGES OF KÖNIGSBERG AND OTHER PUZZLES.

By J. F. [illegible]

The ancient and university town of Königsberg is situated on the river Pregel, which here forms an island called Kneiphof. There are seven bridges over the river, five of which connect with the island In the earlier part of the nineteenth century a discussion arose as to whether it were possible for a person to pass over all the bridges in one continuous trip and without covering the same path twice. In fact, this problem attracted the attention of the celebrated mathematician Euler In order to understand the question clearly, refer to the map The start may be made from any point. The problem is really insoluble, try however you will However, if it be considered allowable to cross the Pregel by the railroad bridge below the town, the problem may readily be solved Thus, beginning at a point on *D* one passes over the Holz Bridge, then over the Schmiede Bridge to the island, then back to *C* by the Krämer Bridge. One now makes a detour, passing over the Pregel from *C* to *B* by the rail road bridge, then passes to the island by the Grüne Bridge, returns over the Kötte Bridge, goes over the Hohe Bridge from *B* to *D*, and finally completes the journey by crossing the Honig Bridge onto the island. Thus, seven—in fact, eight—bridges have now been crossed and no part of the path has been covered twice.

This type of problem may fittingly be termed a *traveling puzzle* It is in reality a very ancient kind of thing Thus, there has come down to us from the time of Pythagoras, who flourished in the sixth century before the present era, a very simple example in the shape of the Pythagorean star an illustration of which is annexed, Fig 2. This figure may readily be traced by one continuous line and without duplication of the path

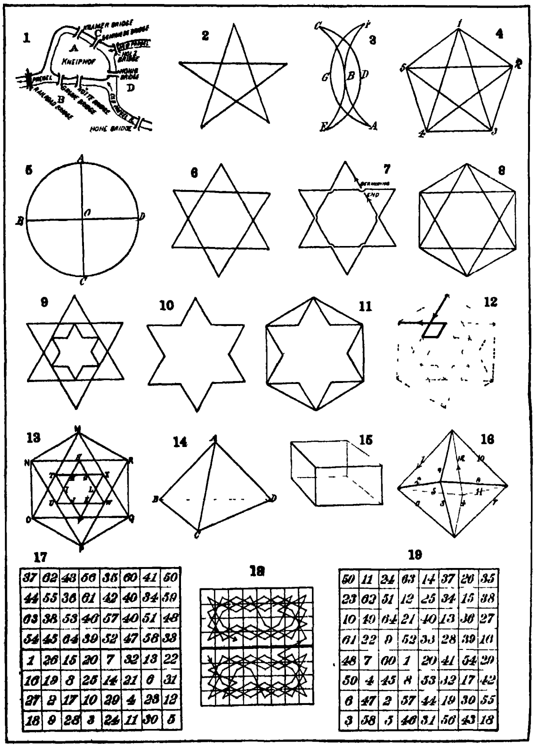
A story is told to the general effect that a disciple of Pythagoras once fell sick at an inn, where he was cared for very kindly by the innkeeper Instead of getting better, however, he grew worse. At last, with the expectation of dying and being unable to repay his kind host, the Pythagorean asked for a board. When this was brought, he traced out the single-line star Giving this to the innkeeper, he desired him that it should be displayed outside. Some time after his burial, a stranger happened along. Upon observing the star, he made inquiry, and was informed of the particulars related. He then, in order no doubt to make the story complete, handsomely rewarded the innkeeper for his unselfish care of the unfortunate Pythagorean.

Another figure of the single-line type is that known as Mohammed's signature. This is shown in the annexed drawing, Fig. 3. It is understood to have been drawn by Mohammed upon the sand by a continuous and unrepeated movement of the point of his scimetar Beginning at *A* and following the course indicated by the letters *ABCDEBFGA*, one may see how it was possible to accomplish this result.

An extension of the Pythagorean star is shown in Fig. 4. This may be solved by following the routes indicated by [illegible] and [illegible]. In these it will be noticed that two or more exterior sides are taken consecutively If it be required that this shall not be the case, the problem is perhaps somewhat more difficult. Nevertheless, it is soluble, as may be seen by following out the order indicated by 14315325421.

We must not be deceived by the apparent simplicity of a given case of this type of puzzle. Thus Fig 5 discloses the very simple figure made by a circumference and two diameters. Try as you will, you cannot cover this figure by a continuous line that nowhere duplicates itself On the other hand figures that are apparently very complicated frequently admit of a ready solution Thus, the six pointed star shown in Fig 6 may be quickly solved by the method shown in Fig 7 To work the puzzle given by Fig. 8—that is, the star of Fig 6 with the including polygon—observe Fig 7 This does not in its present form, perhaps, suggest a solution for the reason that beginning and ending at the point indicated, we have no opportunity to draw the inclosing hexagon, either as a preliminary to starting or as a sequel to finishing But at the moment when we have arrived at the tip of *any* of the six points of the star we may draw this hexagon, and then continue according to Fig 7

Refer now to Fig 9 This is apparently a very complicated design. There is a very simple solution, however, which Figs. 10, 11, and 12 will assist in developing. It is easy to see how to draw Fig. 10, no matter where we elect to start. If we start at the tip of a point, the including polygon of Fig 9 may easily be drawn as a preliminary or a sequel (Fig 11) There is just one thing to see, and that is how the remainder of Fig. 9 may easily be made by forming a kind of loop at each of the inner points, *A*, *B*, *C*, *D* *E*, *F* (Fig. 11) The method of making this loop is indicated in Fig. 12.



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37	62	43	56	35	60	41	50
44	55	36	61	42	40	34	59
63	38	53	46	57	40	51	48
54	45	64	39	52	47	58	33
1	26	15	20	7	32	13	22
16	19	8	25	14	21	6	31
27	2	17	10	29	4	23	12
18	9	28	3	24	11	30	5

18

19

50	11	24	63	14	37	26	35
23	63	51	12	25	34	15	38
10	49	64	21	40	13	36	27
61	22	9	52	33	28	39	16
48	7	60	1	20	41	54	29
50	4	45	8	53	32	17	42
6	47	2	57	44	19	30	55
3	58	5	46	31	56	43	18

THE SEVEN BRIDGES OF KONIGSBERG AND OTHER PUZZLES.

To draw Fig. 13, we proceed as per Fig 9, except that the moment of arrival at *any* one of the points *G* *H*, *I* *J*, *K*, *L* is selected as the time to draw the innermost hexagon A complete solution is afforded by the course indicated by *M T H S N U I T O V J U P W K V Q X L W R S G* **H I J K L G** *X M* **N O P Q R M.** The heavy letters indicate where the innermost and outermost hexagons are added

Comparing Figs 5 and 13, it may seem hard to realize that one puzzle may be worked and the other not. Perhaps some readers may be inclined to think Fig 5 soluble An actual solution will of course prove that they are right. In the meantime the following considerations may prove of interest There are in all five junction points—*O* *A*, *B*, *C*, *D* If we do not start or end at such a point, we must recede from it for every approach and conversely for every recession there must have been a previous approach Approaches and departures are thus paired off At a starting point however it is possible to have a departure without a previous approach, this would occur when we begin, and only then Likewise at a finishing point, we may have an approach without a following departure, this would occur at the end and only then That is to say there can not be more than two points (the start and finish) where an odd number of lines join In Fig 5 there are *four* such points—*A* *B* *C* *D* This shows sufficient reason for pronouncing this figure insoluble

Let us turn now to solid bodies and look at some of the simpler cases Take the tetrahedron shown in Fig 14 It is certainly a matter of indifference at which vertex we begin so we start at *A* We have the choice of three beginnings It is also evidently a matter of indifference which of these we follow so we pass to *B* Here again the two possible choices are alike so we go to *C* Here the two routes lead to different results—*C* *A* completing a triangle (*ABC*) and *C* *D* closing no figure First we try *CA* Arrived at *A* we are compelled to go to *D* We have now two lines to draw—*D* *B* and *D* *C* We may cover one but not both So then we return to *C* and try *C* *D* Arrived at *D*, we see that if we go to *B* we shall be unable to go any farther So then we go to *A* and thus are forced to *C* Here we stop with *D* *B* undrawn. Referring however, to the discussion of Fig 5 we observe that the tetrahedron comes under the head of the impossible figures, as there are four points where an odd number of lines join viz. *A* *B*, *C* *D*

Fig 15 is likewise an insoluble case having eight points where three lines join Fig 16 is an apparent advance in complication But we observe that all six vertices are junction points for an even number of lines It is in fact a soluble case, as may be seen by following the course indicated by the numerals

Another variety of this same general class of puzzle is the problem which requires the knight to start from a position on the chessboard and cover the whole board by a continuous series of moves no position to be taken more than once. A convenient way of trying this puzzle is to rule with a sharp instrument on a slate the sixty-four squares of the chessboard Wherever you elect to start the knight you mark 1 His next position you mark 2, and so on. The slate on ables false starts and errors to be readily corrected This kind of puzzle has attracted a good deal of attention and has received a multitude of solutions. Thus we may instance the solution given in Fig 17 Here the lower half of the board is covered before any beginning is made with the upper half The two halves are precisely symmetrical with each other, as may be seen by referring to Fig 18, where the path of the knight is indicated by a continuous line This division of the solution into two duplicates is not necessary but is an added refinement In one sense it simplifies matters as we have but half the board actually to solve We are restricted, however as to the point of termination Thus in the present example, the point of beginning 1 having been determined, the point 33—the beginning of the second half -is thereby fixed so 32 must come where it is at present or must be at position 6 Fig 19 is an illustration of a solution where the resulting arrangement of figures has some of the properties of a magic square Thus every column and every horizontal line sums up 260 If the diagonals each totaled the same number 260 then the whole would form a perfect magic square

TERMINATION OF THE RHEIMS AVIATION MEETING

THE WINNING OF THE INTERNATIONAL TROPHY

As briefly noted in our last issue Glenn H Curtiss won the Bennett International Aviation Trophy on August 28th at Rheims. This trophy—a beautiful model of a Wright biplane held aloft by a female figure—was contested for the first time on the date above mentioned France being represented by two monoplanes -a Bleriot and an Antoinette—and one Wright biplane and America by one tiny biplane with a powerful 8-cylinder motor The real race was between Curtiss and Bleriot the champions of the biplane and the monoplane types of flying machines respectively and that the former accurately sized up his rival soon after he reached France is shown by the facsimile reproduction of the postal which he at that time sent our Aeronautic Editor

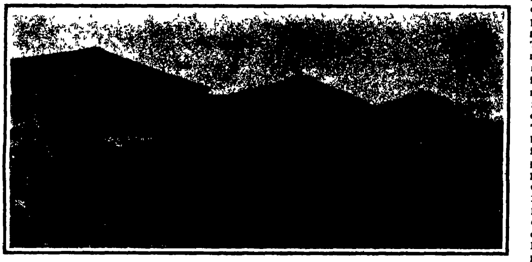
The morning of August 28th was mild calm, and hazy at Rheims. As the weather conditions were so favorable Mr Curtiss brought out his machine a few minutes after 10 and immediately started off on a preliminary round of the course Despite the fact that he made rather wide turns and that the aeroplane pitched considerably the time of the round was but 7 minutes 55 1/5 seconds—a decided improvement over Curtiss's former fastest round of 8 09 1/5 and 9 1/5 seconds less than Bleriot's fastest lap Mr Curtiss decided to try for the trophy at once His small gasoline tank was refilled more water was put in the radiator and after signing the official paper he quickly rose for the second time After circling around once in front of the grand stand he crossed the line at full speed The aeroplane still pitched perceptibly and the turns were with the exception of the very last one all rather wide but nevertheless both rounds were made in record time the second one being 4 1/5 seconds faster than the first and 2 seconds faster than the time in the trial flight The times of the rounds were 7 57 2/5 and 7 53 1/5 the total being 15 minutes 50 3/5 seconds which corresponds to an average speed of 47 04 miles an hour

The 4 1/5 seconds gain in time on the second round Mr Curtiss attributed to a slight change in the mixture which he effected by turning a small wheel he had conveniently at hand He ran the engine at its fastest speed all the time but during the second lap thought that it started missing explosions on one cylinder, so he made a slight adjustment. The pitching of the machine seems to have been due to the fast speed at which it was being driven in conjunction with the sensitiveness of the horizontal rudder control. When the machine would pitch downward and Mr. Curtiss would turn it upward again, the shock was so great that he said it was like striking a bump when riding in a fast automobile

The Curtiss biplane which won the International Aviation Trophy.

This machine made one circuit of the course at the rate of 47 78 miles an hour It traveled 18 63 miles in 15 minutes 50⅗ seconds (47.04 miles an hour) in winning the International Trophy

The other main event of the day—the Prix du Tour de Piste, or 10-kilometer speed test for one circuit of the course—did not bring out any contestants, since the two events could not be run together and since competitors were obliged to state for which prize they were competing But one trial was allowed for the International Trophy also After Curtiss's excellent flight, no other machines were brought out till about noon, when M Bleriot made a slow round with his 80-horse-power 'No 22' monoplane. About 2 P M. he tried another propeller, but only succeeded in making a round in 8 14 1/5 An hour later he had changed the 2-bladed propeller for a 4 bladed one He attempted to make a round, but was obliged to descend before completing it. After working at the monoplane where it alighted for over an hour with the aid of several mechanics, he at length flew back to his shed. As it was now almost 5 P M., and as no start was allowed after 5.30, he made hurried preparations for the test. It was 5 10 before the start was made. The monoplane flew splendidly without any rolling or pitching. The time of the first round was but 7 47 4/5, which was 5 2/5 seconds faster than Curtiss's second lap. If Bleriot could do as well in the second round, he would be the winner There was intense excitement among the spectators at the grand stand The machine finally rounded the last pylon The timers called the seconds remaining before his time would be up, but it was 5 3/5 seconds over Curtiss's 15 50 3/5 before the indomitable Frenchman crossed the line After conquering the Channel he had finally been defeated for lack of speed. Nevertheless, the performances of his and Latham's monoplanes remained unsurpassed for stability, even in strong winds The latter started in the cup competition just as Bleriot was finishing He flew at a great height—about 150 feet—and covered the course in 17 minutes, 32 seconds, thus securing third place. Lefebvre, the third French representative, with a Wright biplane fitted with a 40-horse-power motor, was fourth in 20 47 Mr Cockburn, who represented England with his Farman biplane, got half way around the course when the end of one plane struck a standing shock of corn whirling the aeroplane around and bringing it to the ground Latham met with a similar mishap afterward when carrying M Sariano as a passenger in the passenger-carrying competition This was won by M. Farman, who, after making a round with one passenger in 9 53 4/5, afterward carried two around the course in 10 39 2/5, or at a speed of 34 96 miles an hour The total live weight lifted by his machine was in the neighborhood of 450 pounds. A Wright biplane carried Fraus Reichel around the course in 11 05 4/5 Farman's biplane was the only machine that succeded in carrying three people. Bleriot's 'No 12" monoplane, however, was the first aeroplane to accomplish this feat which it did at Douai last June, when a total weight of 1 234 pounds was carried at about 30 miles an hour with a 30-horse-power motor Farman's biplane had a 50-horse-power Gnome revolving-cylinder motor This engine was fully described in SUPPLEMENT No. 1729

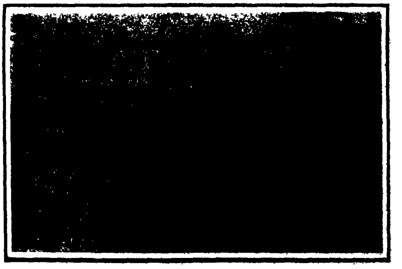


The Bleriot monoplanes in front of their sheds.

The No 22 machine was fitted with an 80 horse-power 8-cylinder motor It made the fastest round of the course at the rate of 47 78 miles an hour

In addition to winning the International Trophy Mr Curtiss, the following day, carried off the first prize ($2,000) in the 30-kilometer speed contest, known as the Prix de la Vitesse. His first attempt was made early in the afternoon The three rounds of the course were made in 24 minutes 15 1/5 seconds. Believing that Latham had made better time, he made another attempt. This time he made very short turns and drove his machine at even greater speed The three rounds were made in 7 49 2/5, 7 48 3/5, and 7 51 1/5, the total time for the three laps being 23 minutes and 29 seconds, or a speed of 47 6 miles an hour The second lap was made at a speed of 47 78 miles an hour, which was the fastest time for the course by any machine, with but one exception Because Mr. Curtiss did not start in this contest on the first day of the meeting he was penalised 1/20th of his actual time, so that his official figures were 29 minutes and 48 seconds. Latham made another attempt to better his previous record, but in this he was unsuccessful.

Bleriot started about 10 o'clock with the intention of making another trial in this competition. He crossed the line and made the first turn at a rapid rate, flying at a low elevation. He finally disappeared from



Postal card showing how Curtiss sized up his opponents.

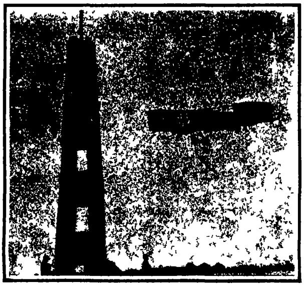
THE RHEIMS AVIATION MEETING.

One of the winning Voisin biplanes.

General view of the aviation field as seen from the grand stand.

Sommer flying in his Farman machine.

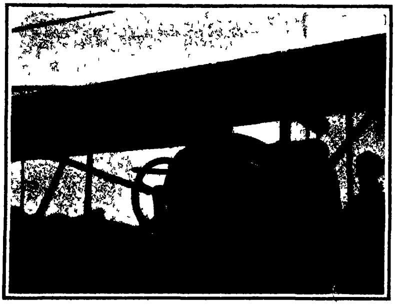
Roger Sommer, aviator.



Paulhan circling a pylon in his record endurance flight.

60-horse-power, 8-cylinder water-cooled motor of the winning Curtiss biplane

All valves are mechanically operated and the ignition is by magneto. The bore and stroke are both 4 inches. The weight is 200 pounds.



Glenn Curtiss, the winner of the International Aviation Trophy, at the wheel of his biplane.

Weight of the aeroplane loaded 700 pounds, total surface [illegible] square feet. Speed 47 73 miles an hour Thrust developed by propeller, [illegible] pounds.

THE RHEIMS AVIATION MEETING

view at the far end of the long side of the course. It was supposed that he had passed out of view in the depression at this point, which was called by Curtiss the "Aeroplane Graveyard" on account of the strong wind currents there and the many machines which met with accident at that point. Soon, however, a column of smoke arose, and upon going to the spot in an automobile it was found that Bleriot's machine had dived to the ground, caught fire, and was rapidly being consumed. M. Bleriot was rather badly burned and received numerous bruises. His only explanation was that something must have broken about the rear horizontal rudder, which caused him to lose control of the machine so that it dashed to the ground The gasoline tank was broken and the fuel quickly ignited from the motor

Another machine which was wrecked at this time was a rather heavy biplane built and flown by M Louis Bréguet This machine made its short flight the evening before. On Sunday morning a short flight of about 300 feet was made, the machine alighting without injury The next time flight was attempted, however, the machine shot upward to a height of about 100 feet and, after traveling a short distance and dipping to the right, it descended at a sharp angle until the low end of one plane struck the ground and swung the machine around, while it at the same time reared up on its prow Fortunately, M Bréguet was not injured

The results of the Prix de la Vitesse were therefore as follows

First, Glenn H Curtiss, with his 60-horse-power biplane. Time 23 29, official time with penalization 25 49 2/5

Second, Hubert Latham, with "No 29 Antoinette monoplane Official time, with penalization 26 33 1/5

Third, Tissandier with his Wright biplane Time 28·59 1/5

Fourth, Lefebvre, with a Wright biplane Time 29 minutes.

Fifth, Count de Lambert, with a Wright biplane. Time 29 02

Sixth, Latham, with "No. 13" Antoinette monoplane. Time, with penalization, 29 11 2/5

Seventh, Paulhan, with a Farman biplane Time 32;49 4/5

Eighth, Bunau-Varilla, with a Voisin biplane, Time, with penalization, 42 25 4/5.

The other speed contest, the Prix du Tour de Piste, which was for one circuit of the 10-kilometer (6.21-mile) course was won by M. Bleriot, who covered the distance in 7 47 4/5 (47 78 miles an hour) Curtiss's time of 7 48 2/5 for one round in the Prix de la Vitesse gave him second place in this contest.

The Prix de l'Altitude or Height Competition ($2 000 prize) was won by Latham who reached a height of 155 meters (508 5 feet) as recorded by a barometer upon his monoplane Farman was second with a height of 110 meters (360 9 feet), Paulhan third with 90 meters (295 3 feet) and Rougier fourth with 55 meters (180 4 feet)

The Prix des Mecaniciens was won by M Bunau Varilla with a distance of 100 kilometers (62 1 miles) to his credit while M Rougier was second with 90 kilometers (55 9 miles)

The Prix des Aeronauts ($2 000) for the fastest five circuits of the course a total distance of 50 kilometers (31 06 miles) was won on Sunday by the large dirigible 'Col Renard" the time being 1 14 49 The smaller dirigible 'Zodiac" covered this distance in 1 25 01 The average of the winner was 24 9 miles an hour

A NOVEL CANTILEVER GRAIN ELEVATOR.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN

The discharge of grain from the holds of vessels economically and efficiently, as well as expeditiously is a problem which involves the solution of many problems of a peculiar character During the past few years many developments in this direction have been carried out at the discharge ports of England in the handling of the grain received from abroad especially in regard to the port of London There the conditions are probably unique, for not only has the grain to be discharged from the vessel's hold to dock elevators, but also to lighters and other craft for conveyance by water to numerous other points

Many applications have been devised from time to time for accomplishing this work to the best advantage and recently conspicuous interest has been centered in a new cantilever elevator with which the grain handling equipment of the London Grain Elevator Company of Silvertown E has been reinforced This plant has been designed by the grain company's engineer Mr Alfred H Mitchell to whose courtesy we are indebted for the accompanying illustrations and information and its operation and convenience in working has compelled general approval It is designed for discharging grain from a ship s hold to accompanying craft and as may be seen from the illustrations it is of the self propelling pontoon contained type It is so constructed that it can be brought to work either side-on or end on to the ship and has the additional advantage when working end-on that it can deliver to two barges at the same time whereas should the conditions such as a narrow dock or a tideway necessitate its being worked side-on its advantages are in no way less

The elevator at rest upon the pontoon's deck for transit. This view well shows the parallel motion of cantilever arm and balance weight.

The elevator in mid-position as it would be when half way down into a ship's hold.

A NOVEL CANTILEVER GRAIN ELEVATOR.

The outstanding feature of this apparatus depends not so much upon the formation of the elevator proper as upon the mechanical combination of levers whereby it is manipulated As is well known, the conditions of working grain from ocean going steamers vary very considerably in point of size of the steamers to be unloaded and the manner in which the grain is stowed On commencing to discharge the grain being right up in the hatchway is probably at a height of some 15 or 20 feet above the waterline necessitating the means of putting the lower end of the elevator into the grain at this height and delivering in the manner required Shortly afterward when the elevator has sunk well into the cargo of grain the bottom point may require to go as low as 20 feet below the waterline that is to the bottom of the ship

When the vessel is discharged it is necessary to lift the bottom end of the elevator over the highest point of the ship s coamings which may then be as much as 40 feet above the waterline This means that the lower or digging end of the elevator must have a vertical range of some 60 feet to comply with the foregoing conditions It is equally apparent that the clear length of the leg below the supporting arm must be sufficient to bottom the deepest hold of any ship which may extend to 40 feet for a moderate-sized steamer and of course much more in some ocean going grain carriers. Another vital factor in connection with the ship is the width of beam Most craft being divided by longitudinal partitions placed amidships, and in the after hold by a tunnel over a propeller shaft it is of the utmost importance that the elevator should be adaptable to working on either side of the ship's center line

The general method by which this end is accomplished is either by means of a portable machine lifted into the ship by means of the latter's boom and resting upon beams placed across the hatch coamings or by means of a pneumatic machine The first is accompanied by grave risk in lifting the machine in and out, and moreover is slow and costly in operation owing to the time involved in installing the appliance and removing it when done with the time consumed in this operation often being in excess of that occupied in withdrawing the grain. With the pneumatic machine great expense is incurred in manipulation, owing to the enormous wear and tear as well as the horse-power required, though it is admittedly useful for dealing with awkward stowages, such as in forepeaks and lazarettes

The peculiar conditions prevailing therefore can best be met by some such appliance as this new cantilever system which is independent of the ship's gear, excepting in so far as the latter is used for plowing the grain to the leg of the elevator after it is lowered into the hold. In ordinary discharge elevators an arm of considerable length is fitted to the top of a tower, and counterbalanced by a weight mounted on the back end. In floating elevators, the disadvantage of this arrangement is that in the first place the enormous topweight necessitates the use of a very large pontoon, and secondly, that owing to the radius of the arm being definitely fixed, it cannot be adapted to ships of different widths, or for working to port or starboard of the partitions referred to, except by the slow and difficult process of booming the barge off from the ship, or the ship off the quay if the latter type of machines are used.

The first development in the evolution of the cantilever elevator was the bringing down of this top balance weight, and carrying it on levers at the back of the post. If the lever be equal in length to the back end of the jib, and the suspending link be equal in length to that portion of the post above the link, a parallel motion results, whereby the weight is moved equally with the back end of the jib, and balances it as before The result of this arrangement is that the top weight formerly required to balance an effort of some 400 foot-tons in an ordinary-sized machine, is greatly reduced, which brings about a corresponding reduction in the dimensions of the pontoon.

The final development of this design by Mr. Mitchell is that shown in the accompanying photographs. Here the post, which in the former designs was rigid, is now itself supported by a trunnion at the top of a frame, which is mounted on a turntable on the pontoon deck. By this combination it becomes possible to shorten the length of the cantilever arm by the amount which the vertical post could swing forward, thereby not only bringing about an appreciable reduction in the weight of the cantilever jib, but also reducing enormously the amount of weight which is required to balance it. Assuming the elevator leg to be perfectly balanced by the jib balance weight, the center of gravity of the whole combination will pass through some definite point on whichever side is uppermost of the post. This point being found, it becomes possible by ballasting the lower end of the tilting post to bring the center of gravity of the whole combination to the middle of the trunnion pin, at which point it will remain, no matter what the position of the elevator This arrangement not only secures the bringing down of the weights to a very low point, but by means of the compound balance thus obtained, the elevator can be worked side-on or end-on, in broad or narrow ships, without imparting to the barge the slightest tendency to list or alter trim, so that a very small pontoon can be used to carry it. The smaller the dimensions of the latter can be made, the easier it is to handle and tow, and what is more important, the less space it occupies at the ship s side or in dock This is a distinct advantage in connection with ocean liners, where often general cargo has to be handled at the same time as grain is being discharged

In actual practice the full weight of the elevator leg is not absolutely balanced, there being a certain excess allowed on the elevator end for sinking the leg into the grain This excess in the ordinary way would produce a list or alteration of the trim of the pontoon, and so in order to counteract this, a weight is fixed under the turntable at a certain distance aft of the center line, and of such proportions that the amount of the weight multiplied by that distance is equal to the excess moment of the other side As a result the horizontal balance remains constant and perfect, and will not produce any list so long as the cantilever jib remains horizontal When the jib is raised or lowered out of the horizontal, however, it will be apparent that there is a very slight alteration of moments, which however is not sufficient to produce any perceptible alteration of trim in the pontoon.

The elevator shown in the accompanying illustrations is among the first of its type to be constructed on these lines, and is now doing duty in the elevator dock on the Thames at Silvertown. Its leg is telescopic, and has a length when extended of 41 feet clear under the suspending pin. The buckets are carried upon an endless chain, and are so arranged that as the telescopic leg is lifted, the exact amount of chain that is let out on the front of the leg is taken up in the back, so that the chain remains of the same length and of an even tension throughout. The buckets, which are 10½ inches apart, have a capacity of 100 tons of wheat per hour, working at full speed, and deliver at the rate of 320 buckets per minute.

The elevator, carried at the end of a cantilever jib, is 35 feet long center to center, 9 feet 6 inches at the back end, and the weight of the leg is partly balanced by the weight at the back, connected by means of the parallel bars and lever shown and already described. The grain is discharged from the elevator head by means of suitable adjustable chutes on to an endless conveyer band, carried on the inside of the jib. This band is of canvas with rubber on one side, and is provided with flanged ribs on the face, to facilitate the grain running up hill when the jib is [illegible] lowered, into its lowest position. These ribs are placed diagonally, to permit them to run freely over the supporting rolls, which carry the slack side of the belt. At the top of the post this belt discharges into a second receiver, which by means of the long telescopic chute shown discharges into the boot of a second elevator, which is placed on the deck, which in turn raises the grain and empties it into the weigh-house or hopper, from which it is delivered to lighters alongside.

The jib of the elevator is carried at the top of the inclined post, which in turn is supported at the trunnion pin at the top of the frame, which rotates upon the turntable, the supporting ring and rack of the latter being secured to the bottom of the craft. The length of the tilting post above the trunnion is 30 feet, and the height of the trunnion pin above the bottom of the pontoon is 17¼ feet. The weigh-house is fitted with six automatic grain scales of 250 pounds capacity each, and these can discharge into sacks or loose into lighters, as may be desired

A noticeable feature of the machine is the celerity and facility with which it can be brought in and out of action. Once it is moored alongside, the leg can be swung round and lowered into the hold ready for working within about four minutes, and this is considerably less than is possible by any other method. A portable machine to be rigged up ready for working takes from two to three hours, according to the position of the ship's winches and the weather Moreover, the great advantage of facility for instant adjustment of the elevator to any width of ship, or for lifting the leg instantly from one side of the ship to the other over shifting boards or propeller tunnels, is perfectly obvious. Again, not only does this machine render possible the use of a single instead of a double leg, but in the event of there being hatch-beams or other obstructions in the hold, it facilitates the placing of the leg in the position required immediately, while in a big hatchway the possibility of being able to sweep the hatchway to its full extent with the combined movements of slewing and post tilting, thereby saving a considerable amount of trimming, is a conspicuous advantage. The exact adjustment of the telescopic leg or the height of the jib also makes it possible to work different consignments of grain in the same hold which are only separated by mats or cloths, as the depth at which the leg is to work can be adjusted to a nicety As may be seen in the illustrations, the combination of the two levers and the telescopic leg gives a great range of action.

The precise angle of the jib is controlled by means of an electric winch and wire hauling gear, acting on the back end of the jib while the tilting of the post is performed by means of a screw and nut carried in a bracket near the trunnion pin of the post. All the controlling actions are performed by series-wound motors of 4 B. H P, and the elevator is driven by a 20 B. H P motor attached to the turntable The direct current at 110 volts is generated on board the pontoon by means of a gas engine and suction gas plant driving a dynamo by belting. The deck elevator is driven from a countershaft in the engine room and a chain belt as described.

The whole apparatus is controlled by one man for whom a cabin is provided on the turntable. A deck-hand assists in adjusting the chutes when getting the elevator to work, and afterward attends to the suction gas plant. The maneuvering requirements of the machine are signaled by a man on the grain vessel's deck, who indicates the exact desired position of the elevator, and follows its operation

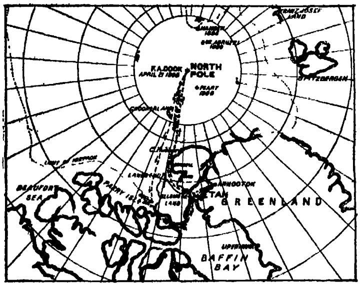
DR. COOK'S DISCOVERY OF THE NORTH POLE.

The search for the North Pole, which began in the Middle Ages for the purely commercial purpose of finding a sea passage to the wealth of the Orient, and which continued to attract adventurous and scientific spirits long after a more direct route to the Far East was discovered, seems to have culminated in the success of Dr. Frederick A. Cook, of Brooklyn, N. Y. Dr. Cook announced the remarkable result of his expedition in a telegraphic dispatch sent on August 24th from the Shetland Islands, where he stopped for two hours on his way south to Copenhagen Although no definite scientific proof is as yet available of Dr Cook's claim, there can be but little doubt of his great triumph. His previous experience in Arctic exploration and his acknowledged intrepidity are conceded even by those geographers who are disposed to await his arrival at Copenhagen.

Dr. Cook's polar expedition seems to have been quite unpremeditated. In 1907 he accompanied John R. Bradley, a wealthy sportsman, on an Arctic shooting trip in a small converted Gloucester fishing schooner When they arrived at the limit of navigation in Smith Sound late in August, 1907, the conditions seemed so favorable for a successful polar dash that Cook determined to make the attempt. In that venture he was undoubtedly favored by a combination of fortunate circumstances. Many Esquimaux had gathered on the Greenland shore at Annootok for the annual bear hunt Great quantities of meat had been brought in by the hunters. Dogs, too were numerous Since food and dogs were plentiful both prime requisites in any polar expedition, Dr Cook promptly decided to make an attempt to reach the Pole, 700 miles distant. The entire village of 250 people fell to and fitted him out, so that before the end of the long winter night he was ready to set out and to follow a route of his own choosing over Grinnell Land and northward along its west coast out on the polar sea.

The expedition started on February 19th 1908, with 11 men and 103 dogs drawing 11 sledges. At the very outset the usual hardships of the Arctic explorer were encountered The crossing of Ellesmere Sound was accompanied by a drop in the thermometer to 83 deg. below zero Fahrenheit. Several dogs were frozen to death Eventually Land's End was reached Game was plentiful In this march to Land's End no less than 101 musk oxen 7 bears and 335 hares were killed, there was no lack of fresh meat

At a point 460 miles from the Pole Cook sent back all his Esquimaux but the two most capable and all his dogs but 26 On March 21st the final effort began A great stretch of open water was crossed—how Dr Cook does not tell us in his dispatch Presumably he used a collapsible canvas boat, which he casually includes in the description of his outfit. On March 30th new land was discovered in latitude 84 deg 47 min longitude 86 deg. 36 min No time was lost in exploring the new country This was the last land that Cook traversed. Thereafter his course lay on the frozen polar sea.



THE COURSE FOLLOWED BY DR. COOK AND HIS IMMEDIATE PREDECESSORS

The game which had previously been so plentiful was conspicuously absent Even microscopic life could not be found. Curiously enough, the surface of the ice pack opposed fewer obstacles than at the outset On the other hand, violent winds hampered him On the night of April 1st, 1908 the sun appeared at midnight over the northern ice The next day found Cook at latitude 86 deg. 36 min and longitude 94 deg 2 min In other words, he had covered about 100 miles in nine days and was 200 miles from the Pole.

Dog after dog was killed to supply the other animals with food as well as Cook and his companions On April 14th latitude 88 deg 21 min and longitude 95 deg. 52 min. was reached The pole was 100 miles away The few stretches of open water were covered with young ice, so that no difficulty was encountered in crossing them.

On April 21st the first corrected altitude of the sun gave 89 deg. 59 min 46 sec. The Pole was only a few miles distant. The remaining 14 seconds were covered by April 21st, 1908, on which day Cook planted the American flag at the North Pole, or rather on a shifting bed of ice which was then at the North Pole

Cook remained at the Pole for two days On the 23rd he started back Keeping his course well to the southwest, in order to allow for the easterly drift, he covered considerable distance during the first few days. Food became so scarce that for a time it seemed questionable whether Cook and his companions would not perish by starvation. Cloudy weather an indication of approaching summer as well as violent gales made his journey southward difficult. Eventually he reached Crown Prince Gustav Sea, with its vast expanse of open water Fortunately, a few bears were shot, and the diminished food supply was replenished. In July Cook crossed the Firth of Devon into Jones Sound Eventually Cape Sparbo was reached, where game was plentiful An underground den was dug, in which Cook and his companions lived until sunrise of 1909 February 18th a start was made for Annootok and the Greenland shores were reached on April 15th

Contrasting Cook's achievement with Peary's exploit of 1906 in which year Peary reached latitude 87 deg. 6 min 200 miles from the Pole we find that Peary started about three weeks earlier in the season Cook's outfit was probably inferior to Peary's hastily prepared as it was. Peary was compelled to turn back because of the great stretch of open water that confronted him Cook was undeterred by water possibly because he carried with him the canvas boat mentioned

Peary's attempt is particularly interesting because Dr Cook started out with the avowed intention of avoiding some of the drawbacks which had beset Peary One of these drawbacks was the general set of the floe to the eastward, with which Peary had to contend Dr Cook, it is understood struck off to the westward for the purpose of making allowance for this floe when he started on his direct north route

Dr Cook is not a novice at exploration He was surgeon and ethnologist in the first Peary expedition in 1891 92, assistant in command of the Miranda expedition which ended in disaster in 1894 surgeon and anthropologist of the Belgian Antarctic expedition which was gone between the years 1897 and 1899, and surgeon in the Peary expedition of 1901 This record must be amplified by the inclusion of his feat as the first conqueror of Mount McKinley in Alaska about which there has been some controversy

It is the prevalent view among geographers that there is no land in the neighborhood of the North Pole This opinion is based upon the fact that no Arctic land is known to rise except from the continental shelf or from comparatively shallow waters But north and northeast of Franz Josef Land the "Fram" expedition under Nansen found depths of 2 000 fathoms or more and fifty miles to the north of Alaska the Nikkelsen-Leffingwell expedition was unable to reach bottom with its sounding line which measured 2 060 feet These and other ascertained facts have encouraged the belief that there is no land around the North Pole Dr Cook now confirms these geographical surmisings.

The mere quest for the Pole itself is not regarded even by Arctic authorities as an especially worthy undertaking What are the conditions of the sea and its currents the air the ice the life of the region and other phenomena between the known Arctic and the Pole? The answer to such questions as these is what is expected in these days of trained explorers No doubt Cook will be able to add much to our scant knowledge on these points

The Norsemen probably were the first Europeans to visit the Arctic regions and Greenland The struggles to find a short cut to the riches of the Far East were more productive of adventures and loss of life than the latter-day dashes for the Pole Perhaps the earliest of scientific explorers was Sir Hugh Willoughby who sailed in 1553 for the search and discovery of northern parts of the world" He discovered Nova Zembla, but starved with most of his men in Lapland on the return voyage

The following explorers emulated him

	Deg	Min
1588—John Davis England ship	72	12
1594—William Barents Holland ship	77	20
1607—Henry Hudson England ship	80	23
1616—William Baffin England ship	77	45
1773—J C Phipps England ship	80	48
1806—William S Scoresby England ship	81	30
1827—W A Parry English sledge	82	45
1852—E A Inglefield England, ship	78	21
1854—E K Kane American sledge	80	10
1868—K Koldeway Germany ship	81	5
1870—C F Hall American ship	82	11
1871—C Weyprechte Austrian sledge	82	5
1875—G S Nares, England sledge	83	20
1879—George De Long American ship	77	36
1882—A W Greely American sledge	83	24
1894—C F Jackson England, sledge	81	20
1895—F Nansen Norway sledge	83	14
1897—W Wellman American, sledge	81	35
1897—Duke of Abruzzi Italy, sledge ..	86	33
1901—Baldwin Ziegler, American sledge	81	45
1901—R. E Peary American, sledge	84	17
1903—Ziegler-Fiala American, sledge	82	
1905—R E Peary American sledge	87	6
1908—Dr Cook, American sledge .	The pole	

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

COAT-HANGER.—I. Freshman, New York, N. Y. This invention relates especially to the cords or chains which are attached on the inner side of the collar to enable the same to be hung upon a hook. The purpose is to provide an anchor plate which can be readily secured to the material of the garment. There are two of these anchor plates provided and they are connected by a chain.

Electrical Devices.

IGNITER.—G. W. Sage, Eureka, Cal. The improvements are in igniters for use in connection with internal combustion engines, and more particularly to that type of igniter in which two electrodes are brought into contact and then separated at the instant it is desired to produce the spark. It relates to that type disclosed in the previous patent granted to Mr. Sage.

TELEPHONE MOUTHPIECE.—G. H. Reed, New York, N. Y. The invention refers more particularly to means for rendering the mouthpiece antiseptic and for increasing the volume of the sound transmitted. The diaphragm and pad may be readily removed or replaced, and the mouthpiece in presenting a large bell-shaped outer end increases the effect of the voice upon the diaphragm of the transmitter.

ROTARY CONVERTER.—J. T. Murdock, Boundbrook, N. J. Mr. Murdock's invention pertains to so-called "current shaping mechanism," his more particular object being to produce a converter for selecting from three-phase alternating currents predetermined portions of said currents in such manner as to accumulate the effect of the portions thus selected, and thus build up a virtually direct current which is practically constant.

Of Interest to Farmers.

GIN COTTON-SEED CLEANER.—H. A. Moss, Kennett, Mo. This cleaner is a shaking screen for cleaning gin cotton-seed by removing therefrom hulls, loose cotton, dirt and sand. It is adapted and used for securing cotton-seed discharged from the gins, and separates from the seed the cotton and hulls which are conveyed to a storage bin, the cotton being subsequently returned to the gin to be re-ginned, whereby an important saving is effected.

THERMOMETER-HANGER FOR INCUBATORS.—G. H. Lee, Omaha, Neb. In this case the invention refers especially to thermometers when used in incubators or in similar situations where it is desirable to have the bulb supported adjustably so that the level of the bulb may be regulated and placed at any point desired.

PLOW.—S. A. Estabrook, Jr., Ponchatoula, La. In the present patent the invention is in plows, and has for its purpose to provide means to vary the sweep of the plow, whereby the soil may be thrown from furrows close to growing plants at each side and the plow thus used for different spaced rows.

Of General Interest.

CAMERA.—A. L. Richardson, Melrose, New Mex. This invention has reference to improvements in photographic apparatus and is applicable chiefly to cameras used in photographic studios for the purpose of making portraits; also it may be used with other cameras such as those used for taking landscapes or for other outdoor photographs.

HIGH-SERVICE DAM.—R. Griswold, Denver, Colo. The purpose here is to provide novel details of construction for a high-service dam that adapt the dam for erection in a gorge or canyon near the highland, so as to arrest a portion of the water drained therethrough and produce back water for irrigation of the soil over which the arrested water is returned.

EAVES-TROUGH.—Lizzie H. Dickelman, Forest, Ohio. The aim in this instance is to provide a construction whereby to increase the strength and rigidity of the trough when the sections are coupled together and at the same time to provide a construction in which the process of manufacture is simplified and in which the sections may be more quickly and easily put together and disconnected when desired.

Hardware.

NAIL-HOLDER FOR HAMMERS OR HATCHETS.—W. E. Wieland, Durango, Col. One purpose here is to provide details of construction for the handle of a nail driving tool such as a hammer or hatchet, which convert the handle into a magazine, wherein nails of a selected dimension may be carried, and by a shaking movement of the handle be passed through a longitudinal slot in the hollow body thereof, and hang by their heads projected from the slot, to be manually removed as desired.

Heating and Lighting.

INCANDESCENT-LAMP SOCKET AND SWITCH.—T. L. Cash, Portland, Ore. This invention relates to incandescent lamp sockets and the intention of the invention is to improve the construction at the socket and particularly that of the switch for turning the lamp on or off. Means are provided for making signs visible that indicate that the current is turned on or off.

CONDENSING SYSTEM.—S. Woolf and C. W. Rafferty, Lynch, Neb. An object of the invention is to provide means for disposing of the exhaust steam by condensing the same, thereby providing means for overcoming back pressure. Means also provide for removing impurities carried along with the steam, thereby leaving the feed water in a pure condition for immediate re-entrance into the boiler.

Household Utilities.

SAD IRON.—G. P. Clements, New Milford, Pa. The iron has an adjustable extension adapted for opening and pressing seams, ruffles, tucks, etc. In retracted position the extension conforms to the outward contour of the iron. It retains heat much longer than small irons, yet is capable of ironing small and complicated work even more thoroughly than small irons, besides avoiding the necessity of having several sizes of irons.

BED ATTACHMENT.—H. L. Appleton, Shelby, Ala. In this patent the intention of the improvement is the provision of an attachment for hospital beds or the like, easily removed or replaced, for containing sponges and instruments, and so arranged as not to interfere with the use of the Kelly pad or similar drainage devices.

CURTAIN-FIXTURE.—J. Darling, Chicora, Pa. The improvement here is particularly in that class illustrated in Mr. Darling's former patent. The construction permits the convenient utilization of the ordinary curtain rollers on the market and provides for securing the same in the hook bracket in such manner as to prevent any accidental displacement of the shade when applied for use.

CLOTHES-DRYING DEVICE.—J. M. Teach, Santa Monica, Cal. The aim here is to provide a drier erected in the open air which affords a device that is very convenient in use and well adapted for the reception of a considerable number of pieces of clothing or other fabric that are to be exposed to the sun and air.

Machines and Mechanical Devices.

CUTTER-HEAD.—J. F. Stedman, Newburg, Ore. Mr. Stedman's invention has for its more particular purpose the provision of an improved mounting for securing the cutters upon the cutter head in such a manner that the cutters may be readily attached and detached at will, and may also be adjusted as desired without removing them from the cutter head.

WAVE-MOTOR.—C. W. Hicks, Los Angeles, Cal. A purpose of this inventor is to construct a motor particularly automatic in action, wherein a pier is built out into the ocean or equivalent body of water a desirable distance, in connection with which tracks are employed, having an inclination upward in direction of the shore, upon which tracks a motor carriage is adapted to travel.

WIND-MOTOR.—C. Dale, New York, N. Y. The more particular purpose of this invention is to provide a type of wind motor in which there are two sets of wind wheels turning in planes which cross each other, the combined effect of all of the wind wheels being transmitted ultimately to a shaft or other driven member common to all of the wind wheels.

FILLING DEVICE.—E. N. Gaudron, Hasbrouck Heights, N. J. The object here is to provide a device more especially designed for filling bottles and other receptacles with liquids contained in kegs, barrels, vats, tanks and other storage vessels, and arranged to automatically stop the filling at the time the bottle is filled, to prevent the return flow into the storage vessels and thus avoid displacement of sediment.

REDUCING-VALVE.—T. P. Ford, New York, N. Y. The valve is more especially designed for high pressure fire systems and the like, and arranged to permit variable pressures from a common supply, such as a hydrant, to allow, for instance, use of several hose of low and higher pressure for outside work. Use is made of a valve casing having a connection with the hydrant or other water supply, and provided with a plurality of outlets for connection with separate fire hose, and main piston valves arranged within the said valve casing for controlling the flow of water to said outlets.

Prime Movers and Their Accessories.

FLUE-CLEANER.—J. Winchmann, Albany, N. Y. This cleaner thoroughly cuts the scale from the inside of the flue or tube by the use of a cutter head rotating with the turbine wheel and provided with a cutter wheel mounted to rotate loosely on the end of a centrifugal swing arm, so that the center pin of the turbine wheel is relieved of undue strain and a proper cutting of the cutter wheel is insured without danger of breaking the latter or causing it to stick in the scale.

Designs.

DESIGN FOR A PICTURE-FRAME.—A. Kaiserman, Rochelle, Ill. This neat ornamental design for a picture frame comprises a frame of an inverted kite shape, the frame standing by a prop support on a flat surface. A cord and tassel hangs from the top point, and a tube-shaped projection extends from the center of the article.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions, books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of March 13th or will be sent by mail on request.

(12121) O. M. T. asks: A local steam plant has been supplying steam for some time to several power plants in this city. They have two boilers of 100 horse-power each. They have been supplying about 200 horse-power steam through a 4-inch steam line about 500 feet long. To do this took altogether too much coal. They used about eight tons per day. They dropped off 100 horse-power of this load, and it only takes three tons or less per day, using one boiler only. What is the explanation? Would the size of steam pipe make any difference in the amount of coal used? A. The size of the steam pipe might easily affect the coal consumption per horse-power generated. Without further particulars as to the distribution we cannot say exactly, but supposing that half or more of the total horse-power is consumed by engines half or more of the total distance from the boilers, a 4-inch main is certainly small enough to cause an appreciable loss of power. It is probable, however, that the boilers are overloaded, and a reduction by half of the power consumption might well cause a greater proportionate reduction in the fuel consumption.

(12122) C. H. P. asks: We have two tanks lying horizontally. One is 6 feet 6 inches in diameter and 29 feet 6 inches long, and there is 24½ inches of oil in this tank. The other is 6 feet in diameter and 25 feet 8 inches long, with 32¾ inches of oil (from bottom of tank to top of oil). How many gallons in each tank? Please give formula used if possible. A. Your question is not very clear, as you refer to the distance from the *bottom* of the tank (usually meaning the circular flat bottom) to the top of the oil, but as you refer to the tanks as lying horizontally, we presume you mean that the axis or longer dimension is horizontal, and mean by the bottom the curved side of the cylinder lying on the ground. In this case the volume of the oil is the product of the length of the tank by the area of the segment of a circle of which the surface of the oil is the chord. The area of such a segment is calculated by the formula

$$\left(A = \frac{4h^2}{3}\sqrt{\frac{D}{h} - 0.608}\right)$$

in which A is the area, h the height of the segment (in your case the depth of the oil) and D the diameter of the circle of which the segment is part. The derivation of the formula is difficult, involving higher mathematics, which you presumably do not want, but its results are very closely approximate. In your first case D = 6 feet 6 inches = 78 inches, and h = 24.5 inches, so

$$\left(A = \frac{4 \times 600.25}{3}\sqrt{\frac{78}{24.5} - 0.608} = 800.33\sqrt{2.576} = 800.33 \times 1.605 = 1284.5 \text{ square inches.}\right)$$

So the volume of the oil is 1,284.5 × 29 feet 6 inches = 454,713 cubic inches = $\frac{454{,}713}{231}$ gallons = 1,968 gallons nearly. With the above example you can easily calculate the second amount, substituting h = 32.75 and D = 72 inches, and multiplying the area found by 25 feet 8 inches.

(12123) P. O. B. 35 asks: Does a 22-horse-power automobile develop more horse-power in "low" than in "high"? I am sure it does not, but just to prove it to the fellow with whom I am betting I am asking you. Do you answer by letter or in the next SCIENTIFIC AMERICAN following the receipt of the question? A. We make it a rule not to settle bets, but as we can only guess at the meaning of your question we do not mind stating a general principle from which you can draw your own conclusions. Supposing that your question has some reference to the change-speed gear of an automobile, no amount or kind of gearing can alter the power generated by any engine. If a man can lift 100 pounds through one foot in a second with his hands, but can raise 1,000 pounds with a fall and tackle, he must continue for ten seconds expenditure of the same amount of energy per second required to raise the smaller weight in order to raise the 1,000 pounds 1 foot, because where he gains in mechanical advantage, he loses in speed. In the same way with an engine, if a certain number of revolutions producing through gears a given torque on the wheels will drive a car 20 miles an hour along a level road, a greater torque is required to drive at even a much less speed up a steep grade. The engine speed is therefore reduced by the increased load, and, as a high speed is necessary for efficiency in gasoline engines, a change of gear is made which allows the engine to run as fast as before while the wheels turn more slowly, thus distributing the same amount of work over a longer period and overcoming a heavier load, but the power generated is the same, power being the work done divided by the time consumed in doing it. This is not to say that the output in brake horse-power of an automobile or any other engine is always the same, but merely that it cannot be affected by the gearing.

NEW BOOKS, ETC.

MODERN ACCOUNTING. By Henry Rand Hatfield. New York: D. Appleton & Co., 1909. 12mo., 367 pp. Price, $1.70.

This is a most valuable treatise, giving in lucid style the best principles of accounting. The essence of accounting from the author's viewpoint is the presentation first of a careful exhibit of a definite status of the concern at a given moment of time, and secondly a showing of the results obtained during a given period of time. The first is embodied in the balance sheet, the second in the income or profit and loss statement. The presentation of a correct view of a concern's financial status and of its past profits involves many points of theoretical interest and practical import. The present volume will do much to give those who are charged with the ultimate revision of figures most valuable information. The chapters relate to Principles of Double Entry Bookkeeping, Balance Sheet, Assets and the Principles of Valuation, Valuation of Particular Assets, Mutual Assets, Depreciation, Capital Stock, Liabilities, Profits, Surplus and Reserve, Sinking Funds, Trading, Manufacturing, and Income Accounts, Cost Accounts, Partnership Accounts, Statement of Affairs and Deficiency Account, Technical Improvements in Accounting Practice. The subjects treated are very well arranged and the book will certainly be of great value to the heads of business corporations as well as those who are charged with the actual accounting.

HANDBUCH FÜR HEER UND FLOTTE. Enzyklopädie der Kriegswissenschaften und verwandter Gebiete. Herausgegeben von Georg von Alten, Generalleutnant z. D. Vollständig in 108 Lieferungen reichillustrierten Textes mit farbigen Beilagen, Karten, Plänen, Gefechtsskizzen etc. Deutsches Verlagshaus Bong & Co. Price per part, 50 cents.

The last five installments of this admirable military and naval encyclopedia contain some excellent articles on tactics, most of them historical in treatment and some based upon the results of the recent Russian-Japanese war. Among these may be mentioned the articles entitled "Aufklaerung," "Aufmarsch" and "Ausdehnung der Gefechtsfront." Some excellent articles on historical battles and sieges are to be found under the headings "Aspern," "Austerlitz," "Bayaume," "Bar sur Aube," "Bautzen," "Ath," "Badajos," and "Barcelona." European military geography is also discussed, particularly under the headings "Athen," "Baden," and "Bayern." Among the numerous articles of general military interest may be mentioned those entitled "Aufgebot," "Aufnahmen" and "Aushebung," while some special technical subjects will be found discussed under such titles as "Bajonettangriff," "Attacke," and "Batteriedeckungsbau," which last is most admirably illustrated. Among the naval articles of more than passing mention are those under the headings "Artilleristische Maschinen der Kriegsschiffe," "Atlantischer Ozean," "Ausstossrohr," "Azimut," "Babcock und Wilcoxkessel." Military hospitals and military sanitation are ably discussed under the titles "Arznei- und Verbandmittelversorgung," "Aerztliche Fortbildung," "Atmung," "Augenkrankheiten," "Bakteriologie," and "Baracken." A very clear presentation of military and legal relations, in other words, the subject of military jurisprudence, will be found under the titles "Ausland" and "Auswanderung." For the first time we find an exhaustive review of the historical development and the military value of expositions.

MY SYSTEM. Fifteen Minutes' Work a Day for Health's Sake. By J. P. Müller, ex-Lieut. of Engineers, Klampenborg, Denmark. With forty-four illustrations and a time-table. Translated from the fifth edition of the Danish original. New York: G. E. Stechert & Co. Price, in colored paper covers, 75 cents net; red cloth, gold lettering, $1 net.

Müller's book "My System" has become almost a household word in Germany. Indeed, it is referred to in more than one German comic journal with humorous approval, as well as in such literary works as Andrejev's "Geschichte von den sieben Gehengten." The system described is an excellent arrangement of gymnastic exercises intended to consume not more than fifteen minutes a day and yet to develop the physique. There can be no doubt that if the suggestions of this book are carried out, a weak body can be scientifically built up.

A NEW LIGHT ON ANCIENT EGYPT. By G. Maspero. New York: D. Appleton & Co., 1909. 8vo., 315 pp. Price, $[illegible] net.

Prof. Maspero is one of the [illegible] Egyptologists in the world, and he states in his Preface that he has been fifteen years trying to bring a science, supposed to be comprehensible only to experts, within the reach of the ordinary man, and it is gratifying to [illegible]

[illegible] been wasted. He has drawn his material from everything than can be discussed with educated people, without demanding anything more than a little attention. Excavations, religion, travels, popular customs, literature and history have each and all furnished him with subjects. The result is a living picture of the researches made in the domain of Egyptology during a period of fifteen years. The book is a most fascinating one to all who have even a slight appreciation of what Egyptology really means. Many chapters deal with the very latest discoveries and matter that has never before appeared in book form.

The Life of Major-General Sir Charles William Wilson Royal Engineers, K.C.B. K.C.M.G., F.R.S., D.C.L., LL.D., M.E. By Colonel Sir Charles N Watson. New York E. P Dutton & Co., 1909 8vo., 419 pp. Price, $5.

The material from which this memoir of the late Sir Charles Wilson has been compiled consists principally of his own diaries and notebooks, which he always kept in a very thorough manner; all his official reports printed in Parliamentary papers and all other public writings, and more especially, all his letters to his wife, which recorded everything which he did and saw during his travels. Sir Charles Wilson's career was a remarkably varied and interesting one. He was selected to serve on the North American Boundary Commission. For many years he served upon the Astronomical Survey, and had charge of that department in Scotland, Ireland, and afterward in the United Kingdom. He also was employed by the War Office Foreign Office Survey under Lord Dufferin in Egypt. Sir Charles was prominent in his close connection with the Soudan question and the mission of Gen Gordon. In the Nile Expedition of 1884 he held the important position of Chief of the Intelligence Department. Sir Charles Wilson had many interests in life outside of his military and political positions and probably did more than any other man to increase the knowledge of the geography and archæology of Asia Minor, Palestine and adjacent countries. The book is an entertaining one to those who care for memoirs.

Stained Glass Windows in England By Charles Hitchcock Shirrel New York J Lane Company, 1909 12mo., 254 pp. Price, $2.50 net.

This admirable book is a rational guide to the study of stained glass in England. It is accompanied by maps which show how the cities may be visited in their proper sequence with as little fatigue and crossing of one's path as possible. Not only are many noble cathedrals visited but smaller religious edifices and secular buildings of many types are treated. In this latter category are treated the universities of Oxford and Cambridge and one of the finest of the stately homes of England—Knole. Any cultivated person who completes the tour as outlined will have obtained a well rounded impression not only of glass but also of history, as well as an intelligent insight of the customs of England. Unfortunately no form of illustration can hope to reproduce the combination of light and color which makes up the beauty of stained glass. Those selected by this book are the best obtainable, but are chiefly useful in showing how the windows are set. It is not a technical book, so that scale drawings are not required. It is a beautifully printed and bound book.

Happy Hawkins By Robert Alexander Wason. Boston Small, Maynard & Co, 1909 16mo., 352 pp. Price, $1.50.

"Happy Hawkins" is a quick-tempered, independent, loyal, lovable, adventurous, and philosophical cowboy of the plains. He tells his own story in his own way, and after a plan of his own. His knowledge of human nature, his simple-hearted devotion to those he loves, his ability to get into trouble and out of it, his self-possession in any society—all these qualities make him one of the most original characters in modern fiction. Mr Wason tells a story full of red blood, with action, romance and the interplay of hot human passions with an intricate plot, an abundance of incident, a great variety of scene and type, shrewd philosophy, genuine pathos, and, perhaps best of all, real fun and humor on nearly every page. It covers the growth from childhood to womanhood of Happy's little playmate, Barbara, the daughter of his employer "Cast Steel" Judson, of the Diamond Dot ranch and swings round from Wyoming to Texas, Nevada, California, Montana, and back again. The book easily establishes the author's reputation as a great story teller and fun maker.

Legal Notices

PATENTS

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Pen stock, J A Fleming	932,450
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Shovel W Beebler	[illegible]
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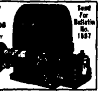

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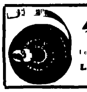

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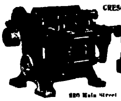

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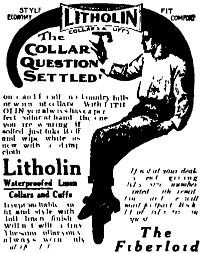

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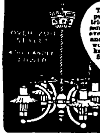

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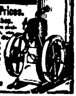

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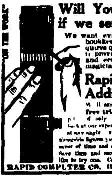

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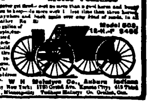

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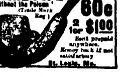

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NEW YORK, SEPTEMBER 18, 1909

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OUR ARCTIC EXPLORERS.—[See page 196.]

The greater length of time required by Cook to reach the Pole may be explained in part by comparing the Arctic steamer "Roosevelt" of the Peary expedition with the fishing schooner in which Cook reached the Arctic regions.

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NEW YORK SATURDAY SEPTEMBER 18th, 1909

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic* the contributions will receive special attention. Accepted articles will be paid for at regular space rates

HONOR TO WHOM HONOR IS DUE

Within the last two weeks announcement has been made of one of the most romantic and interesting achievements connected with the history of exploration since the day of Columbus The announcement of the discovery of the North Pole was one which fired the imagination of the most torpid and stimulated the enthusiasm not only of scientific men, but the whole civilized world

The knowledge that this elusive goal, which has baffled the energies of man for so many generations had at last been reached naturally led to universal rejoicings and much national pride.

Within a few days the announcement of this discovery was followed by news that another American explorer had reached the same goal

This natural feeling of exultation was, however, quickly dimmed by the criticisms and accusations which followed the first cable dispatches which made it patent to all that the claim of one of the explorers was to be disputed by his rival and that the public was to be treated to a long drawn-out and tiresome controversy

It is unfortunate that the daily press, in its eagerness for news items and for copy controversial and sensational in character, should have seized upon these exceptional circumstances, with a view of fomenting a bad feeling which was regretted by all and that in many cases, it should have taken sides, not with the view so much of reaching the truth as to become partisans in a controversy, with a view of stimulating circulation and private gain This deplorable attitude is not confined to this country, as the same journalistic policy is noticeable in the foreign press. This is a mere condition of the times.

The truth in regard to both these explorations must and will be known. Honor must be given where it belongs.

It is a somewhat unusual precedent to doubt the statements of discoverers, especially when they had been connected with any particular line of exploration for a period of many years. It is most fortunate, however, that the two parties to the controversy should both be Americans, and that there is no danger of the dispute assuming an international aspect.

Those who are in a position to judge of these matters—the scientific men who have interviewed the explorers—are many of them of the opinion, at the time we are going to press that the description of the exploration of Commander Peary tends to confirm the conditions as described by Dr Cook

Of all fields of human endeavor, there is none to which the world has been ready to accord greater respect than that of geographical research, and, because of the multiplied dangers and hardships of Arctic travel, the men who have pushed out farthest in the quest of the North Pole have been especially favored with national attention and municipal honors.

With a unanimity out of all proportion to the results to be obtained it has come to be recognized that the most valued prize of the few that remained to be won by the explorer was reserved for him who should first set his foot upon that point which forms the northern extremity of the earth's axis. With the slow passage of the centuries, each bearing away its roll of men who have sacrificed their lives in the effort to solve the secrets that lie within the Arctic Circle, the quest for the North Pole had come to take on moreover, a certain color of romance which detracted nothing from its dignity as a serious scientific problem, and the record of unwearied patience, heroic courage and sublime self-sacrifice which has marked these centuries of polar exploration, has served to place both the men and their mission upon a very high plane of human regard.

Therefore we look upon it as most regrettable that the almost simultaneous announcement by two American explorers that they had reached the North Pole should have set on foot an undignified controversy of world wide notoriety For here we have no mere difference of opinion between two private individuals. One of the disputants, at least, by virtue of the fact of his bearing a high commission in his country's service, and each of them as having but recently planted the flag of his country at the very peak of the world, must necessarily speak and act as a distinguished representative for the time being, of his native land Whatever of disappointment, or of fancied or actual wrong, may have been felt by the sender of that accusing dispatch from Labrador, consideration of the dignity of the navy and the nation should have sealed his lips.

REPORT OF THE CHIEF OF ORDNANCE.

For the average civilian, the most interesting section of the last report of the Chief of Ordnance of the United States army will be that which deals with the new 14 inch gun, which for the future will constitute the principal weapon in our scheme of coast defense. Of the five guns of this type provided for by Congress, four are to be built of concentric cylinders assembled by shrinkage in accordance with the system heretofore in use, and the fifth is to be of the wire-wound type. The manufacture of two built-up and one wire-wound gun is well under way, and the construction of the other two built up guns will be undertaken as soon as the forgings can be procured

The motive for the design of the 14-inch gun was the desire to produce a weapon that would not be subject to the destructive erosion of the bore that characterizes the present 12-inch guns of high velocity, which is so severe that the 12 inch piece, with a muzzle velocity of about 2,500 feet per second is so badly worn away in the rifling after firing less than 100 rounds that the projectile fails to bite on the rifling and leaves the muzzle of the gun with insufficient speed of rotation As a consequence the axis of the projectile fails to remain true to the line of flight, or trajectory, and the projectile itself begins to turn end over end and fails to strike the target head on. The rapid wear of the interior of the bore is supposed to be due to the extremely high temperature which accompanies the high powder pressures that are necessary to give high velocity Since the striking energy of a projectile is equal to the product of its weight and the square of its velocity, it is possible, by increasing the weight of the projectile, to decrease the velocity without a loss of striking energy This is what has been done in the case of the 14-inch gun, which as compared with the 12-inch gun firing a 1,000-pound shell at 2,500 feet per second, will fire a 1,600-pound shell at about 2 100 feet per second and with a much lower powder pressure and temperature. The decrease in the erosion is expected to give the 14 inch gun more than double the accuracy life of the 12-inch gun.

The report tells us that in the design of the 14-inch gun the question has arisen as to which of the two methods of construction gives the longer life to the gun, the use of a relatively large or of a relatively small powder chamber and propelling charge Under the former set of conditions the maximum pressure corresponding to the prescribed muzzle velocity will be appreciably less than under the latter conditions, but the powder charge will be correspondingly greater, and experience has indicated that erosion is affected not only by the maximum pressure of the powder gases but also by the weight of the propelling charge in guns of the same caliber. To determine which method to follow, tests have been made of two 3.5 inch guns, whose ballistic data are exactly similar to those proposed for the 14-inch guns, in accordance with the two systems above described These firings will be continued until it has been definitely ascertained under which of the two sets of conditions the accuracy life of the gun is the longer

A new 6-inch, wire-wrapped rifle, with ballistics identical with the 6-inch rifle of the model of 1897, is to be built, in which the use of a superior quality of steel in the tube and the substitution of a wire envelope for the steel jacket will not only greatly increase the elastic strength of the gun but will reduce the weight about 25 per cent and will somewhat reduce the cost. A new design for a 12-inch wire-wrapped mortar, of the same power but weighing 30 per cent less than the 12-inch mortars now in our fortifications, has recently been completed. The question of erosion is the most serious one confronting the Board of Ordnance. Extensive tests with the 0.30-caliber rifle have shown very clearly that the erosion is three or four times as rapid with a propelling charge of nitroglycerin powder as with one of nitrocellulose powder, and that the temperature has a great deal to do with the erosion [illegible] temperature of combustion [illegible] about 2,500 deg. C., that [illegible] only about 2,300 deg. C. It is [illegible] that, if it were practicable to so modify the composition of our smokeless powders as to reduce the temperature of combustion, erosion would become a much less serious factor Here is a problem for the chemist, the solution of which would win for him one of the richest prizes in all the history of military and naval inventions.

Experiments have been carried on with the object of extending the accuracy life of cannon by the use of a rotating band on the projectile, considerably wider than that now employed. We gather from the report that the ordnance experts expect that the wider band will merely insure better rotation of the projectile when the rifling is worn, but that they do not anticipate that it will prevent erosion.

The SCIENTIFIC AMERICAN has for many years been of the opinion that erosion is largely due to the abrading effect of the rush of gases at high velocity past the projectile, and that if this were prevented by more perfect obturation, or closing up of all interstices between the shell and the gun, the erosion would be greatly, if not altogether, eliminated. Although the report makes no mention of the fact, we understand that experiments with a new form of rifling band acting in conjunction with a packing material at the base of the shell, have shown most encouraging results, regarding which we hope to give further information at a later date.

THE COMPOSITION OF THE UPPER ATMOSPHERE.

The composition of the air at great altitudes has long attracted the interest of meteorologists. In the earliest ascensions of unmanned registering balloons, twelve or fourteen years ago, attempts were made to secure specimens of air from the upper strata of the atmosphere. In one case half a gallon of air was thus collected Its analysis showed a composition identical with that of air near the earth's surface. The system of monthly ascensions which was subsequently instituted revealed the remarkable phenomenon of the "permanent inversion layer" The diminution of temperature with increase of elevation, which was observed at all lower levels, was found to cease at a height of about 10,000 meters (33,000 feet), above which level the temperature was found to rise, slightly but regularly, with increase of elevation. This upper warm stratum has been found everywhere, in the tropical and temperate zones, near the Arctic circle, and over the Atlantic Ocean.

The discovery of this singular reversal of the temperature gradient suggested a possible difference in the composition of the atmosphere at high and low levels. The French meteorologist Teisserenc de Bort, although he did not share this opinion, undertook an experimental investigation of the subject. He suspended from a sounding balloon a glass tube closed at both ends and with one end drawn out to a fine point, which was sealed in a flame after the tube had been completely emptied of air At a certain height an electrically driven hammer broke off the fine end of the tube and admitted air. The tube was then sealed again by the heating of a platinum wire by current from a small storage battery The electrical contacts required to effect these operations were made either by the barometer at a prescribed elevation or by the clockwork of the meteorograph. The glass tube was suspended at a distance below the balloon which prevented the entrance of a trace of escaping hydrogen.

In this way specimens of air were collected at various heights in July, 1907 Another series of experiments was made on the Atlantic Ocean from the "Otaria," but the salt contained in the sea air made the electrical contacts unreliable.

The specimens collected were too small for ordinary chemical analysis, but they were tested, by special methods, for argon, neon, and helium. Argon and neon were found at all heights, from 26,000 to 46,000 feet. The characteristic yellow line of helium appeared in the spectrum of most of the specimens, but no trace of helium was found at the highest level (46,000 feet)

For the year 1911 there is being organized in Italy, under the patronage of King Victor Emmanuel, a celebration in honor of Amadeo Avogadro, this being the centenary of the publication of his celebrated memoir concerning the molecular state of gases and the well-known law which bears his name as to the change of volume of gases with temperature. His researches laid the foundation for chemical as well as physical theory. A committee has been formed under the direction of the Royal Academy of Sciences of Turin, and it is taking measures to publish a memorial volume containing his most important monographs. Besides, there is to be erected a monument to Avogadro at Turin, in which city he was born and was professor of science. An appeal for funds is [illegible] are interested in the movement, the [illegible] headed by Senator S. Cannizzaro.

ENGINEERING.

The total length of railway under construction or [illegible] projected in India is 3,222 miles, of which [illegible] is by the British government and the rest by private companies. The estimated cost is over twenty million dollars

The replica of the "Half Moon" built to the plans of the late Heer C L Loder of the Dutch navy and recently brought over for the Hudson-Fulton Celebration, is now being rigged at the Brooklyn navy yard under the supervision of Heer E J Bentham, constructor in the royal navy who built her

The torpedo-boat destroyer "Flusser" built by the Bath Iron Works of Bath, Me for the U S navy, has recently completed the first of her official acceptance trials over the measured knot course off Rockland, Me The average of her five top-speed runs was 32 7 knots, while one run was made in 1 minute 46 4/5 seconds or at the rate of 35 7 miles an hour The latter is nearly three knots faster than the best speed of any boat in the American navy

The Montreux-Berne-Oberland electric railway in Switzerland has installed automatic gates at its grade crossings When the bow trolley of the car comes in contact with an auxiliary wire run close and parallel to the main trolley wire, the current passes through the auxiliary and operates a motor mounted on brackets on the iron gate post swinging down the gate and at the same time lighting lamps and ringing a bell. When the car has passed the gate automatically returns to the vertical position

The Panama Canal authorities have approved the purchase of a 20 inch pipe-line suction dredge made to order for use elsewhere by the Ellicott Machine Company of Baltimore but never used This is expected to be in use before the end of the present year on the hydraulic fill for the Gatun dam making the fourth suction dredger engaged in that work while a fifth will probably be added next year When the dam is nearly complete some of the dredges will be removed to the central division as the water in Gatun Lake rises sufficiently to permit dredging It is estimated that some 4 000 000 tons of material can be more economically removed than by steam shovels

Except for a few short distances totaling 127 miles automatic block signals now extend from the Atlantic to the Pacific Ocean According to the Railroad Age Gazette of the distance unprotected by this system 93,4 miles on the Southern Pacific in the Sierra Nevada Mountains uses the electric train staff The next longest gap 20 miles in length occurs where a change of line is about to be made The remaining gaps are due to bridges and points where changes are in progress. The line thus operated by the block system extends from Jersey City on the Atlantic to Oakland on the Pacific over a total distance of 3 245 miles and it includes the Lehigh Valley Railway to Buffalo the Lake Shore & Michigan Southern to Chicago, the Chicago & Northwestern to Council Bluffs the Union Pacific Railway to Ogden and the Southern Pacific Railway to Oakland.

A very remarkable demonstration of the possibilities of producer gas engines for small boats requiring less than 500 horse-power has recently been made by Mr H L Aldrich in a boat built for the purpose the results being described in International Marine Engineering for August The boat is 40 feet long over all 9 feet beam and 3 5 feet mean draft, and is driven by a four-cylinder four-stroke cycle engine of 35 horse-power and can cover between 800 and 900 miles at an average speed of 8 to 9 miles an hour on one ton of pea anthracite Such a plant can be conveniently and safely installed on coastwise schooners in the lumber and coal trades fishing and oyster boats and the like and in addition to the greater safety with anthracite at $4 a ton the cost of operation is about one-tenth that of a gasoline engine of equivalent power with gasoline at 15 cents a gallon

A train ferry service between Sassnitz in Germany and Trelleborg in Sweden has recently been opened conveying trains across 65 miles of open sea by means of which through train service from Berlin to Stockholm is now possible. The ferryboats two of which are owned by the German government and two by the Swedish State Railways are superior in size, speed and accommodations to any in the world and carry a full train of eight cars on two parallel tracks, the balance being maintained while loading and unloading by special trimming tanks. There is almost no tide at that part of the Baltic but the height of the water varies with the wind, so a double-jointed steel ferry bridge is provided, [illegible] feet long, with a large bolt in the seaward end fitting a hole in the stern of the ferry boat, to insure alignment of the [illegible]. When the cars are on the ferry, they are [illegible] down to the deck by special shackles, the car [illegible] being relieved by screw jacks. Provision is also made for bracing them in heavy weather from the overhead [illegible] of the vessel. The boats have complete and [illegible] restaurant and sleeping accommodation for the passengers in addition to the car space.

ELECTRICITY.

Conversation by a wireless telephone, the invention of two lieutenants of the French navy is said to have been carried on between Toulon and Port Vendres, a distance of 155 miles

The electric process iron smelter at Herould on the Pitt River has recently delivered a carload of pig iron, produced by the electric process at $25 a ton—cheaper than it could be bought at tidewater It is pronounced to be of the finest quality for casting purposes.

The electric power station of the government buildings at Washington is nearing completion It is located in Garfield Park near the Capitol and connected with the legislative buildings by 7 000 feet of tunnels through which cables and steam pipes run The tunnels are large enough for a man to walk through comfortably so that breaks and other troubles can be quickly located and repaired

A transformer was short-circuited by lightning during a terrific storm at the village of Olginate near Lecco in northern Italy on August 18th subjecting the low pressure distribution system to a voltage of 9 000 Attempts to switch off the current by the residents alarmed by the blowing of fuses caused the death of several persons and a number of serious burns

At the Winnipeg meeting of the British Association for the Advancement of Science a model was exhibited by Mr S H Schneider which he claims will revolutionize the generation of electricity It consists of a collapsible airtight box which when closed sinks in water by its own weight On reaching the bottom it is expanded by a magnet when being lighter than the water displaced it rises to the surface where it again folds up and sinks The inventor states that a *full sized generator* ' weighing 600 000 pounds and displacing 10 000 cubic feet would generate 50 000 horse power at practically no cost of operation

Electric-car motormen in Berlin are subjected to three weeks training comprising 20 hours in the classroom and 40 on the cars in each week The course comprises the usual practice on a dummy platform and study of every detail of car equipment as well as sufficient instruction in overhead and track equipment to enable the motormen intelligently to report accidents After the recruit has completed the course he must pass separate examinations by the car engineer and the district traffic inspector Candidates receive half pay during instruction but to cover the cost of training each must deposit $16 which is refunded in full after one year s employment

Judgment has just been rendered in two suits of the Union Carbide Company against the American Carbide Company for infringements of the Willson product patent of 1895 and process patent of 1896 The patents are upheld as valid but no infringement is found Since the defendant company is exculpated of infringement partly on the ground that it manufactures carbide by means of what is strictly a resistance furnace and not an arc and the complainant company has also long relinquished the arc for resistance heating of the carbide materials it will be interesting to see what further steps are taken by the latter

The economical importance of maintaining uniform load factor is well shown by comparison of the records of the Appleton Minn Electric Company for last year and for 1905 prior to the installation of storage batteries. In the latter part of 1905 it was found desirable to maintain a 24 hour service but cost of continuous operation of the generating unit appeared to be prohibitive Chloride accumulators were therefore installed to store the surplus power when the plant was run at maximum capacity during the night and capable of giving out a third of that maximum for eight hours during the day The gross receipts of the company increased by 14 per cent in the *following* year in spite of which the fuel consumption for 1906 was actually less than for 1905 and making due allowance for interest and depreciation the net return on the storage battery investment was 14 per cent

The diary of a traveler from New York to Chicago by interurban trolley' lines published in the Electric Railway Journal of August 28th shows that the limitation of electric-car lines to cities and suburban districts is a thing of the past and that such systems are no longer installed to supply purely local needs or to feed railways The first 115 miles was covered not strictly speaking on a trolley car although most of it could have been, but by the electrified New York Central Railroad to Hudson N Y as a matter of convenience Thence to Chicago all but 72 of the 1 143 miles was traveled on trolley lines in a running time of 45 hours and 24 minutes at a cost of $19 67 The author describes his journey as most pleasant and comfortable, revealing many attractive parts of the country unseen by the steam railway travelers and intends to repeat the trip finding that the running time can be reduced by over 10 hours.

SCIENCE.

Gréhant has studied the disturbances of respiration of various animals confined in an atmosphere in which acetylene was substituted for nitrogen the mixture containing 79 volumes of acetylene and 21 volumes of oxygen A pigeon died in 30 minutes a rabbit in 40 minutes while no effect was produced on a tortoise The respiration of frogs was arrested but when the asphyxiated frogs were brought into the open air they soon recovered their normal condition It appears from these experiments that acetylene is far less poisonous than carbon monoxide but it should be remembered that poisonous gases act very differently on different animals

In a recent number of the Scottish Geographical Magazine a claim is made on behalf of the British government to the island groups of South Georgia South Orkney South Shetland South Sandwich and Graham Land all in that part of the Antarctic continent nearest to America These islands are declared to be a dependency of the Falkland Islands Hereafter no whalers will be allowed to fish in those coastal waters or to make use of the harbors without buying an annual license at the Falkland Islands *This is the first serious attempt to take possession of* any considerable Antarctic area The Antarctic country is now the scene of a large reviving whaling trade

Time is a curious freak at the earth s poles and when Dr Cook says that he reached there at 7 o clock in the morning of Tuesday April 21st 1908 his statement is without certain meaning Presumably he carried Greenwich time in which tables for navigation are calculated So at the time of his discovery it was 2 in the morning at New York As this meridian runs to the North Pole as well as that of Greenwich its time also applies So does the time of every other meridian and in consequence at the same instant it was also 7 o clock Monday afternoon and every hour minute and second in between until 7 o clock Tuesday afternoon At both the North and the South Pole it is always two days at once and every day lasts for forty eight hours

The observed acceleration of the mean motion of Encke s comet was at first attributed to the effect of a resisting medium but subsequent changes in the comet s motion have made this hypothesis untenable Prof Hackenberg has made a preliminary research which appears to indicate that the observed changes may be produced by the action of dense swarms of large meteors Biela s comet is known to have been affected by a swarm or current of meteors which doubtless caused the division of the comet into two parts In 1906 Charlier published an elaborate investigation of the accelerations of the motions of comets which is in harmony with Hackenberg s theory Hackenberg promises soon to apply Charlier s results to the motion of Encke s comet

A German inventor Otto Nicolai claims to have invented a new method of welding aluminium using a specially prepared metal paste with different ingredients At a *certain heat there is formed a mixture of* aluminium oxide and the paste which gives rise to a chemical compound whose nature is not yet determined Excellent welding is obtained for the metal or nearly all of its alloys without any special precautions For aluminium bronzes such as are used for German torpedo manufacture which contain 90 per cent copper and 10 per cent aluminium it is required to add finely divided aluminium powder to the paste This latter must be used in all cases in presence of a great excess of the metal so as to form the above-mentioned compound to secure the proper welding He also solders aluminium to other metals such as copper iron nickel etc In this work he uses large pieces of metal or again thin sheet metal or wires with good results

More than once it has been asserted in good faith but erroneously that diamonds had been produced in blast furnaces In 1896 J Frank treated various products of the blast furnace with acids and obtained a residue composed of titanium cyano-nitride mixed with brilliant crystals all of which except one were very minute The crystals were not affected by mixed nitric and hydrofluoric acids which dissolved the titanium They showed no facets and were very fragile but as they were not attacked by any acid Frank assumed them to be diamonds Nothing further was heard of these crystals until recently when the subject was re-examined by Johanssen in the course of a study of the incrustations formed in two blast furnaces of which one had been in operation 14 years and the other 4 years Johanssen endeavored to obtain titanium cyano-nitride and he succeeded but found that compound mixed with fine sandy particles which were not attacked by hydrofluoric acid and were altogether similar to Frank s crystals But the particles refused to burn in oxygen fused to an opaque mass in the oxyhydrogen flame and dissolved completely in fused borax Analysis proved them to consist almost entirely of alumina.

AN AUTOMATIC ELECTRIC FOG-SIGNALING APPARATUS FOR RAILROADS.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN

Interesting experiments have been carried out upon the Belgian State Railroads with a new system of signaling in fogs a system which is the invention of Mr W de Ruyter van Steveninck, a late officer of the Holland navy now resident in Brussels The important feature of this device is that it is absolutely automatic in its operation, the detonators being electrically fired by the train itself, and in such a manner that a powerful acoustic signal is given beside the track The signal is entirely independent of the operator though operative in conjunction with a visual signal, and always gives an adverse signal should there be any breakdown in any part of the apparatus.

The detonator signal is retained, because it affords the most striking and certain means of warning the crew of a passing train and cannot by any possibility be misunderstood An accident would therefore be directly attributable to willful negligence on the part of the engineer

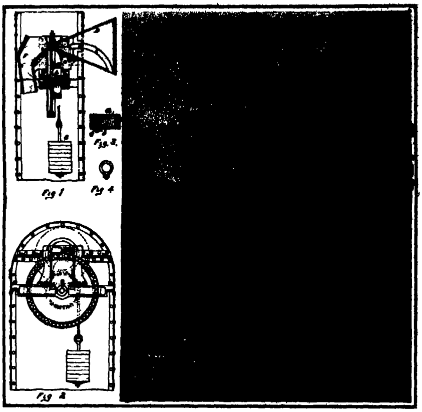
The apparatus comprises a small waterproof pillar box mounted beside the track fitted with a trumpet facing the direction of the approaching train, this trumpet being placed on a level with the engineer in the cab of the locomotive. In this box is mounted a large wheel, provided with a peripheral magazine capable of holding fifty cartridges in grooved sockets. The forward action of this wheel is controlled by a pulley and counterweight, which is wound up like the weights of a clock and which will make one revolution of the wheel clockwise This wheel thrusts forward one cartridge at a time the cartridge being brought to rest in a small space in the neck of the trumpet by a spring buffer

The detonator (Figs. 3 and 4) comprises a cartridge case *a*, to the outside of which is screwed a small metal cap *b* In this cap is inserted a screw *c* insulated from the cap itself by a small tube of ebonite which tube also carries a short length of platinum wire, one end of which is soldered to the point of the screw and the other to the cap *b* which is filled with guncotton The cartridge itself is loaded with common black powder, and is closed at its outer end by a wad *f* The insulated screw in the cap is connected with one terminal of the battery and the cartridge cap itself with the other terminal the circuit being broken at the rail The approaching train as it passes the apparatus closes the circuit, either by means of rail contacts or a treadle placed in the track and immediately the circuit is established the platinum wire in the cartridge cap becomes incandescent and fires the guncotton, which in turn detonates the cartridge The sound of the explosion is deflected through the trumpet as well as the gases of ignition while the wad of the cartridge is blown to the ground through the curved tube *F* (Fig 1) Under the force of the recoil the cartridge case itself is ejected from its socket in the magazine wheel, and falls into a box (Fig. 1) whence it can be easily recovered Immediately after the explosion the magazine wheel, under the influence of the counterbalance weight commences to revolve bringing the next cartridge into the firing position in the neck of the trumpet, the extent of its travel being arrested by the buffer already mentioned, which insures its coming into the correct firing position This brings the apparatus into firing position again The empty cases can be collected and may be recharged, which serves to reduce the working cost of the system The rail contact can be placed either alongside the detonating apparatus or some distance in advance thereof according to the prevailing conditions Although the circuit is established and the detonation is produced as the front wheel of the engine passes over the contact, and the apparatus immediately resets itself, subsequent firing by each successive vehicle of the train is avoided by means of a relay, which cuts out the whole circuit until the last wheel of the train has passed completely by The relay then opens instantly, and sets everything in readiness for the next train. In this way useless expenditure of the cartridges is avoided, only one being fired for each train.

Should the line be clear, the apparatus is cut out of action, and no signal is given. A detonator is fired only when the signal arm is at danger, or when the signaling arrangement breaks down

It is obvious that the apparatus may be set at some distance from the signaling operator's cabin, the occupant of which through not hearing the explosion, may not know whether the signal is fired or not. This event is ingeniously guarded against by means of an alarm to the operator's cabin, which gives indication that the explosion warning has been communicated to the engineer of the train Directly the detonator is fired a contact is closed and a circuit established with an electric alarm bell placed in the signal cabin This bell continues ringing until the operator acknowledges the intimation by breaking the bell circuit by the movement of a switch Similarly, intimation of the cartridge exhaustion of the magazine wheel is conveyed to the signal operator When the magazine has been so depleted that only five cartridges [illegible] the wheel, this alarm bell in the signal cabin commences ringing, and cannot be arrested until the apparatus is recharged. Should the operator ignore this warning, and the last cartridge be fired, the whole of the signaling arrangements are interrupted by locking the apparatus automatically, and their normal working cannot be restored and trains pass by until the apparatus is recharged with cartridges, unless the train engineer willfully ignores the stop signal.

The Belgian experiments, which were of a searching nature, conclusively established the efficiency and reliability of this ingenious system.



AN AUTOMATIC FOG-SIGNALING APPARATUS FOR RAILROADS.

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RAT DESTRUCTION BY ELECTRIC CURRENT.

Besides being harmful parasites, liable to work considerable damage wherever they take up their abode, rats are known to be the dangerous agents of propagation of infectious diseases, especially bubonic plague. Invading freely any vessel lying at anchor in harbors where that terrible scourge exists, they will carry contagion with them to any port touched by the ship, and accordingly present a most dreadful danger which it is hard to fight.

Many methods have, it is true, been suggested during the last few years for the destruction of rats, but none of these has proved free from serious drawbacks. "Smoking" by means of sulphurous acid gas is, for instance, liable to harm the cargo, while evicting the rats with illuminating gas is not free from some danger to the crew As it is, none of these methods lends itself to general use at any place infested by the fearful rodent.

A Viennese engineer, Herr von Florentin, Baron of Biederheim, has recently performed, in the presence of representatives of several administrative bodies, the Imperial Navy Office, etc., at the Charlottenburg Municipal Electricity Works, some interesting tests on an extremely original device, by which the rats (or any other vermin) are literally electrocuted.

This patented apparatus takes advantage very ingeniously of all peculiarities of the rodent. Attracted by curiosity toward an electric lamp or by gluttony toward an appetizing morsel, the animal itself closes the current bound to kill it in a maximum of 50 to 60 seconds. Access to the apparatus is always free, even after this has been filled with several electrocuted animals, and, as shown by experiment, no rat caught by the electric trap succeeds in escaping its fate.

One of the most interesting features of this scheme is that continuous, alternating, or three-phase currents of low tension, e g., 110 to 120 volts, are quite sufficient to electrocute the animals. Such currents are available at present nearly everywhere, and especially on board ship. Should no electric installation be available, it would be sufficient to provide a small accumulator battery, which in spite of its lower tension would produce quite similar effects.

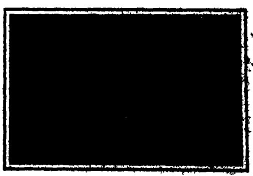
The apparatus can be so arranged that the electrocuted animal itself signals its execution to any desired place, advising the watchman by an electric bell, or the lighting of a red incandescent lamp, that there are some killed animals to be removed The low tension of the current excludes any danger to men, and prevents any accidental electrocution of domestic animals.

The photograph reproduced in Fig. 1 shows the moment the rat prepares itself to enter one of the pigeonholes of the apparatus. Fig. 2 represents the electric trap open, with an electrocuted rat.

This invention is exploited by a company in Charlottenburg.

Top view of trap with lid raised, showing electrocuted rat.

Entrance side of trap with rat about to enter.



Smaller form of trap with single entrance.

RAT DESTRUCTION BY ELECTRIC CURRENT.

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H. H. Weersma has attempted a new determination of the solar apex, or the point toward which the sun and planets are moving. He finds, for the apex, the co-ordinates, right ascension 267.7 deg., declination +31.41 deg. The point thus defined [illegible] constellation [illegible] the star [illegible]

PORTABLE OUTLOOK FOR ARTILLERY TRAINS

BY DR. ALFRED GRADENWITZ.

A novel type of portable outlook for artillery trains has been recently designed by a German firm, the object being to allow men to note the effect of their own fire

As shown in Fig. 1 the limber-pole of a field gun may be used as an observing station. The cartridges are carried in the limber case The pole is hinged so that it can swing vertically A special foot supports it on the ground

Before erecting the pole a rope ladder with a shield is fixed in place. The rope ladder is tightened automatically as the pole is swung into position The protective shield when not in use is carried in front on the gun limber arms and on the case frame and at the same time serves as a foot rest for the men seated on the limber All the instruments used for observation are carried in receptacles below the foot rest as well as in the limber case itself.

The operator is equipped with a strap and hook by means of which he attaches himself to the pole. The rope ladder may be fitted at the top with an additional seat consisting of two rope ends and a transverse beam on which the operator may seat himself (see Fig 2) Instead of a rope ladder the pole may be provided with lateral rungs which when out of use are folded and received in recesses thus eliminating any risk of injuring the horses

Fig 2 represents the limber of a 15 centimeter howitzer The observing station is similar to the one shown in Fig 1 with the exception that it is made up of two poles fastened end to end

In Fig 3 an ammunition caisson is represented for individually located field guns These can be turned up so that the bottom constitutes the front of the shield The armor is thicker in front than on the sides and roof Below the bottom is located the box containing the observation ladder which is likewise armored The ladder is of the telescopic type and can be extended and collapsed by means of a tackle It is equipped with a top seat, telescope support and map table all foldable

Fig 4 represents a three-section observation car The observation ladder is swung up by means of a winch and tackle Because of its height the ladder is held by guy wires All the necessary instruments such as telephones etc are installed in the driver's box

It may be said that observation wagons are by no means new In fact they have been used as far back as in the fifteenth century for scaling the walls of fortresses Later they were used in fighting fire and now we find them restored to their military dignity

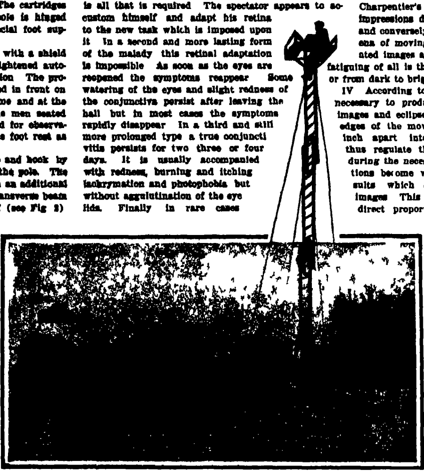

Fig 4.—Three-section observation ladder.

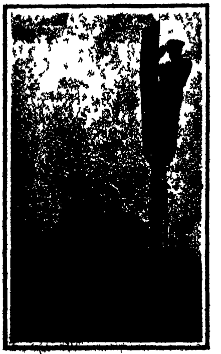

Fig. 1.—Single-section ladder and shield.

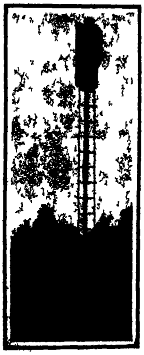

Fig 2.—Two-section ladder

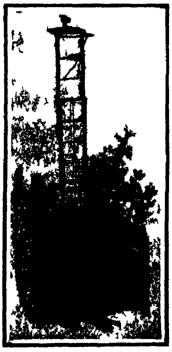

Fig 3.—Telescoping ladder

PORTABLE OUTLOOKS FOR ARTILLERY TRAINS.

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Cinematophthalmia.

The illusion produced by the cinematograph is explained by the persistence of luminous impressions on the retina. The duration of the impression varies according to the intensity of illumination the frequency of interruption, and various other conditions. Its average value is 1/45 second. In order that the moving scene shall be reproduced in a lifelike manner before our eyes, the pictures must move before the lens and follow each other at intervals a little smaller than 1/45 second, so that one impression will remain when its successor arrives, and thus the pictures blend together, to a certain degree.

This series of rapid and brief excitations produces, in time, a certain fatigue of the eyes and more or less persistent ocular troubles. A French physician, Dr Ginestous has studied these troubles and given the name of cinematophthalmia to affections of this character These troubles are fortunately not very serious Dr Ginestous describes several forms. The first form is essentially temporary and consists chiefly in lachrymation and photophobia which compels the patient to close his eyes The trouble begins with the passage of the first picture across the screen In most cases the closure of the eyes for a few seconds is all that is required The spectator appears to accustom himself and adapt his retina to the new task which is imposed upon it In a second and more lasting form of the malady this retinal adaptation is impossible As soon as the eyes are reopened the symptoms reappear Some watering of the eyes and slight redness of the conjunctiva persist after leaving the hall but in most cases the symptoms rapidly disappear In a third and still more prolonged type a true conjunctivitis persists for two three or four days. It is usually accompanied with redness, burning and itching lachrymation and photophobia but without agglutination of the eye lids. Finally in rare cases there are troubles of accommodation accompanied by headache and great difficulty in reading writing and seeing near objects

Ophthalmias of this sort are not usually alarming In most cases they heal rapidly even without any treatment and the most obstinate cases yield to very mild treatment The best remedies are rest and mild eye-washes containing cocaine and adrenaline The principal causes of the difficulty must be sought in the operation of the cinematograph

I Defects in sharpness of the pictures or in focusing the projecting apparatus make the seeing of moving pictures difficult and painful The negatives should be as sharp as possible for the corresponding positives are magnified in projection to nearly one hundred thousand times their area and the defects of sharpness are magnified in the same proportion

II Place of the spectator Charpentier has proved that the persistence of impressions on the retina depends upon the size of the retinal image and that the persistence is less for near than for distant objects Consequently in a moving picture hall the seats nearest the screen are not the best

III Fatigue is caused by luminous impressions which are too strong or too weak According to Charpentier's researches the persistence of luminous impressions diminishes as the illumination increases and conversely This law is confirmed by the phenomena of moving pictures Bright and strongly illuminated images are more fatiguing than others and most fatiguing of all is the abrupt transition from black to white or from dark to bright

IV According to the theory of the cinematograph it is necessary to produce a regular and rapid alternation of images and eclipses In order to obtain these results the edges of the moving film are perforated with holes 4/5 inch apart into which mechanical fingers enter and thus regulate the movement of the film and hold it during the necessary period But in time these perforations become worn and a certain amount of play results which causes vibration and blurring of the images This fault apparently trivial is increased in direct proportion to the magnification of the projected image

V In order to prolong the spectacle some operators move their films with the minimum speed physiologically necessary to produce the persistence of the retinal images Hence the eye is compelled to make an effort to retain and superpose the successive pictures and this effort necessarily causes retinal fatigue The wearing of blue glasses has been recommended in order to avert these inconveniences The director of the Pathé establishment at Bordeaux suggests moving the hand with the fingers separated so as to form a perforated screen before the eyes Dr Ginestous rightly remarks that this device is not very practical

The evil is not very great It suffices to recognize its existence Those persons whose eyes are fatigued by viewing moving pictures have always the recourse of giving up this form of amusement There are many worse privations—Cosmos

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Seeing by Telephone

To allow people conversing by telephone to see one another is known to be the ultimate goal of those inventors to whose labor we are indebted for the evolution of telephotographic apparatus As the problem did not so far admit of any practical solution inventors have in fact been satisfied with transmitting by wire photographic pictures diagrams handwriting and the like According to reports just received from Denmark a satisfactory solution is now offered In fact two young Danes (the brothers Andersen) recently called at the offices of Politiken the well known Copenhagen daily in order to submit to the editor the principle of their idea particulars of which cannot yet be given out Unlike the Korn apparatus optical transmission according to their scheme is not effected by means of any material sensitive to light such as selenium nor is a picture produced by photographic or mechanical means as in all the apparatus so far suggested Transmission in fact takes place simultaneously so as to reproduce any objects situated at the sending station in their natural colors and motions their dimensions however being reduced

The apparatus is connected by a contact with the telephone wire when the acoustic or optical currents can be thrown alternately through the line The operator is thus able at will to show himself or to bring before the eyes of the person at the other end any objects he may like to show him. As the apparatus, so far from being necessarily located immediately beside the telephone can be used within a considerable range provided the contact be obtained, the possibilities of this invention are obviously many Further details will be awaited with interest.

Fake Discoveries.

BY A. F. [illegible]

In the January, 1909 number of the Journal of Industrial and Engineering Chemistry appeared an editorial its contents being given here in part

The agitation against so-called patent medicines, which culminated in the National Food and Drug Act of 1907 also has served to awaken the public to the many deceptions which are being practised, and the many worthless preparations for general domestic use which are on the market The results of this movement have been first, to force a great many of the more palpable frauds to be withdrawn from the market, and second to provide for the correct labeling of all others, so that the purchaser may be in a position to buy intelligently Only those materials, however which may be classified under the head of food and drugs for the human system come within the scope of this legislation '

The writer mentions fake remedies offered in the market for the treatment of hard water for boilers and other products used in quantity in the industries He concludes with an appeal to the chemical profession to take measures to suppress these chemical fakes both by legislative and educational means. It is hard to see why people are so easily led into believing statements made in advertising literature even if indorsed by those in positions of importance who either out of ignorance or indifference have failed to investigate tests made in their presence before going on record as having witnessed them

Some years ago a sample of a chemical supposed to render wood fireproof was submitted to us for analysis A careful examination proved it to be common table salt for which a price of 25 cents a package (about one pound) was asked and undoubtedly was paid by scores of buyers. We know of course that salt acts to a certain extent as a protection but by no means does it make wood fireproof and at the best it is worth less than 1 cent a pound Some time later two samples, one a pink and the other a blue chemical were submitted to us for examination A circular stated that the blue chemical added to gasoline would render it non-explosive the same was claimed for the pink chemical if added to kerosene or coal oil. The circular also contained a number of testimonials from persons whom one would expect should know better but undoubtedly they were not thinking deeply enough to consider what harm could grow out of their indorsement One of the testers, the chief of the fire department of one of our large eastern cities stated that in his presence the chemical was placed in a can containing gasoline the fluid being ignited in the can and poured into another containing gasoline without exploding either of them We wish to state that the oil termed gasoline is not explosive and if ignited in an open can will burn with a smoky flame so there was no merit in the material added It is entirely different if gasoline which has been kept in a partly empty can for some time is brought in contact with a lighted match or candle or if the can should be opened near a flame or light of any kind as an explosion will be the result of such carelessness. The explosion is due to the gases formed in the can and these mixed with air are highly explosive but nothing known at present will prevent this except precaution And if there were a remedy it would naturally have to destroy the qualities of the gasoline which make it valuable, that is its ability to vaporize rapidly and at a low temperature We made an analysis of both chemicals, which were offered at 50 cents a bottle containing less than an ounce of material and found them to be common table salt dyed the colors above mentioned What attracts the attention of the general public at present is a material supposed to make ashes burn It is sold and to our personal knowledge was bought, at very fancy prices We took the trouble to analyse a package and found that it contained powdered calcium carbide with 30 per cent of free lime and coal dust Whether these impurities were purposely mixed or their presence was due to an inferior grade of carbide we did not consider sufficiently important to investigate Any person of average intelligence ought to know that ash is a mineral admixture of coal and is non-combustible All statements made by careless investigators to the effect that the addition of any of these compounds to their coal increased the calorific or heating power are ridiculous, and the good results exist only in the imagination of the user The efficient way to obtain all the heating value contained in the fuel is to have proper grates and draft facilities, and to keep them clean Clinker and ash should be removed by frequent raking since too hard raking carries a large quantity of unburnt coal into the ash There are hundreds of other compounds of a similar nature, which flourish long enough to fill the pockets of the "discoverer," and we cannot caution the reader too emphatically to stop to consider the feasibility of a so-called discovery before buying it and recommending it without having seriously investigated its merits.

A Remarkable Nile Fish.

A very peculiar fish (*Tetrodon fahaka*), which is called "fahak" by the Arabs, is found in large numbers in the Nile at high water The fahak belongs to the group of globe fishes. In its normal condition it is ten or twelve inches long and of elongated shape. A thick mucus covers its entire body, with the exception of the abdomen, which bears numerous spines. The fish has a thick head, with a broad forehead and protruding eyes. The dorsal and anal fins are small, circular, and transparent, the caudal fin is larger, and of orange yellow color In general, the colors of the fahak are bright and harmonious. The back is very dark blue, the sides are striped blue and orange, the abdomen is yellow, and the throat snow white. The mouth is of peculiar shape, each jaw being divided in the middle, so as to produce the appearance of four large teeth, whence the name *Tetrodon*, meaning four-toothed

The most interesting peculiarity of the fahak is its power of inflating itself like a balloon, by drawing in a large quantity of air Usually it swims in the manner of other fishes, but when danger threatens it rises quickly to the surface of the water and begins to pump air into an extension of the gullet. By this means the abdomen of the fish soon becomes so greatly distended that it exceeds the rest of the body in size The fish loses its equilibrium, turns over and floats on its back, and at the same time the spines of the abdomen are erected By this transformation the fahak is protected against the attacks of its enemies. If one of these seizes it, the aggressor is wounded by the spines and thenceforth leaves the unpleasant creature alone If the inflated fish is grasped by the hand it endeavors to draw in still more air, as if it were well aware of the importance of this action to its safety When the danger is past, the air escapes with a slight hissing noise, and the fish gradually resumes its normal form.

The fahak is found in many streams of West Africa, but most abundantly in the Nile which it ascends from the Mediterranean It penetrates into the irrigating canals and ditches, and there lays its eggs. When the flood subsides, great numbers of the fish are left stranded and become the prey of birds of all sorts. They are also eaten by the peasants Occasionally the use of the fish as food appears to cause poisoning There is a story of two American sailors who died soon after eating the liver of the fahak Such cases, however appear to be very rare, and they are perhaps to be attributed to the use of decomposed fish On the other hand the *fugu* fishes, or Japanese species of *Tetrodon* are extremely poisonous. As in the case of the European barbel the muscular flesh is harmless but certain other parts, especially the roe, liver milt, but also the skin abdominal wall and intestines, are so poisonous that they have been used in Japan as a means of suicide and murder from time immemorial In the Asiatic seas fugu poisoning often occurs among sailors and natives and in Japan the sale of all species of *Tetrodon* is forbidden by law The fahak is a great source of delight to the Egyptian children who drive the inflated fish around and harry them until they literally burst. The children also inflate the dried fish and make handballs of them The fahak is often found in curiosity shops, where it is bought by travelers as a memento of the land of the Pyramids. The fahak was known to the ancient Egyptians. Its representation occurs twice on the walls of a temple at Deir-el-Bahari.

Photographic Dyeing.

Sunlight, which destroys many organic coloring matters, also converts some colorless and soluble inorganic compounds into insoluble colored substances, which may thus be fixed in the interior of tissues. Many experiments in dyeing fibers and fabrics by the agency of sunlight have been made, especially by Perner and Grueve The following are some of the results obtained

Sixty parts by weight of sulphuric acid were added to a solution of 120 parts of potassium bichromate in 1,000 parts of water. White wool and silk fabrics were dipped in this solution, dried in a dark room and exposed to sunlight. A beautiful light shade of brown was produced by from 10 to 20 minutes' exposure.

Prussiate of potash gives a medium shade of blue. If white cloth impregnated with this salt is exposed to sunlight under thick paper bearing a cut-out pattern, the design is reproduced in blue on the cloth, which is then rinsed in water to remove the unaltered prussiate from the parts which were covered by the paper

Grüne found that very [illegible] shades of blue, green, and gray can be obtained from [illegible] nides, and brownish violet, black and olive [illegible] nates. For blue, the fabric is dipped in a solution containing 66 parts by weight of potassium ferricyanide, 80 parts of tartaric acid and 54 parts of ammoniacal perchloride of tin, with more or less water, according to the shade desired. A short exposure to sunlight develops the blue color

For green, sulphuric acid and an ammoniacal salt are used in connection with the ferrocyanide or yellow prussiate of potash. Buff shades are obtained by producing blue, as above, and treating the dyed fabric with caustic alkali, which converts the blue compound into yellow ferric oxide.

Gray and "mode" tints are produced by treating buff (obtained as described above) with an infusion of nut galls or Campeachy wood Silk fabrics can be dyed in various shades of brown by impregnating them with copper chromate and exposing to sunlight.

The experiments prove that a certain quantity of moisture is required to produce brilliant colors with short exposure. Probably many substances which are employed in photography would produce desirable results in dyeing, but they are too expensive to be used for that purpose.

The Current Supplement.

The opening article of the current SUPPLEMENT, No 1759, is devoted to a very exhaustive discussion of the wonderful aeronautical meeting at Rheims, France. Some splendid pictures of the more prominent aeroplanes in flight are presented. One of these photographs shows no less than three flying machines in the air One of the most remarkable papers read before the Winnipeg meeting of the British Association for the Advancement of Science was that of Prof Ernest Rutherford. In this paper he explains very lucidly how the modern scientist measures the atom. The electrolytic rusting of iron is discussed by Alfred P Morgan N W Greenway writes on the comparative weights of reciprocating and turbine machinery for marine work. The most notable project for irrigation yet undertaken by the United States Reclamation Service has at last been completed, and will be thrown open to the public on September 23rd, for which reason Albert Wilhelm s excellent illustrated article on the subject of the Gunnison project (the project in question) should be read with some interest. Prof Albert F Ganz of the Stevens Institute of Technology writes thoughtfully on the progress in electric current development in the artificial lighting field A good practical article which will be read with profit by the amateur is Clarence Biggs's "Fitting Electric Bells." Dr D T Macdougal of the Carnegie Institution, one of our greatest biologists, writes on aridity and evolution Prof T J J See has the distinction of being what may be called an astronomical revolutionist. In a paper entitled "The Origin of the Satellites" he sets forth his theory that satellites are in reality captured bodies, and that they did not spring from parent planets as we now suppose.

Official Meteorological Summary, New York, N. Y., August, 1909.

Atmospheric pressure Highest, 30.86, lowest, 29.50, mean, 30 01 Temperature Highest, 93, date, 9th; lowest, 58, date, 4th; mean of warmest day, 82, date, 9th, coldest day, 62, date, 17th, mean of maximum for the month, 78.7; mean of minimum, 64.5, absolute mean, 71 6, normal, 72.6, deficiency compared with mean of 39 years, 1.0. Warmest mean temperature of August, 77 in 1900, coldest mean, 69 in 1903. Absolute maximum and minimum of August for 39 years, 96 and 51 Average daily excess since January 1st, 1 2. Precipitation 7 94, greatest in 24 hours, 5.06; date 16th-17th, average for August for 39 years, 4 64. Accumulated excess since January 1st, 1.15. Greatest precipitation, 10 42, in 1875, least 1 13, in 1881. Wind: Prevailing direction, northwest, total movement, 7,610 miles, average hourly velocity, 10.2; maximum velocity, 40 miles per hour Weather Clear days, 12; partly cloudy, 10, cloudy, 9; on which 0.01 inch or more of precipitation occurred, 9. Thunderstorms: 19th, 20th. Mean temperature of the summer, 71.82; normal, 71.90 Deficiency, 0.07 Precipitation, 13.09; normal, 12.17 Excess, 0.92.

The "Panflex" spring wheel, invented by Hon. R. C. Parsons, of turbine fame, shown in operation at the recent conversazione of the Royal Society, is an invention which has for its object the easy motion of a vehicle when run at low or high speeds. This easy motion is due to the springs being capable of deflection in every direction. The wheel is [illegible] liable, according to its distinguished inventor, [illegible] not subject to bursts or punctures, [illegible] case of wheels fitted with pneumatic [illegible] and tear are small, and should [illegible] is, [illegible] the case [illegible] in a few minutes [illegible]

Correspondence.

A SLIGHT ERROR CORRECTED

To the Editor of the SCIENTIFIC AMERICAN

On page 186 of the SCIENTIFIC AMERICAN of August 21st is an article headed A Record Cross-Country Motor-Boat Trip," in which you place the location of dam No. 6 at Rochester, Pa. Dam No 6 is located about five or six miles below Rochester while dam No 5 is located at Freedom about one and one-half miles above Rochester and twenty four miles below Pittsburg This is a small error and perhaps need not be corrected My only excuse is that I am an interested reader of your paper and have a few moments time to spare DEWITT HOWE

Freedom Pa

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A HEAT PARADOX

To the Editor of the SCIENTIFIC AMERICAN

The fact can be discovered by the physical experiment, that if a conducting rod is heated and then partly cooled very rapidly the quick cooling will increase the temperature of the still hot adjacent section

Therefore a paradoxical phenomenon of heat being directly generated by cold can be demonstrated which depends on the conductivity of the rod and the proportion of the part cooled

The degree of this increase of temperature is directly proportional to the heat of the rod and the degree and the quickness of the cooling.

Force used by the heating in expansion is retransformed into heat of rapid contraction by quick cooling and is conducted along the rod faster than the cold it being yet partly hot and increases it in temperature that can be measured which proves that force from the rapid contraction caused by the quick cooling is conducted along the rod as heat

Lucerne A F WOOD CHENOWETH

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EARLY SUGGESTIONS OF INVADING ENGLAND BY BALLOON

To the Editor of the SCIENTIFIC AMERICAN

The recent crossing of the English Channel by M Blériot has aroused worldwide attention It may be interesting to know that in June 1803 Boulard and Le Campion two French cartoonists predicted the invasion of England by a balloon Boulard s drawing is entitled La Thilorière or the Descent on England Design for a Montgolfière (balloon) capable of carrying 3 000 men and which will cost only 300 000 francs There will be fixed to it a lamp which will give out a volume of flame sufficient to prevent its cooling Extracted from the Publiciste of Thursday 13 Prairial of the year XI [2 June 1803] Paris chez Boulard No 175 Rue St Denis etc Campion s picture designed and engraved by Echard is called The Tower of Calais, new aerostatic machine constructed by M Romain by order of the government to cross from France to England in conjunction with M Pilatre de Rozier A third and still more curious plate shows the invasion of England as carried out by the combined operations of warships flat-bottomed boats, and balloons of all shapes and sizes, while cavalry and artillery approach Dover through a subterranean passage A glance at these cartoons which are reproduced in Messrs. Wheeler and Broadley s interesting work entitled "Napoleon and the Invasion of England shows that the Frenchmen of that period had some gift of prophecy fanciful though it was Although no airships have been built to carry 3 000 men still Zeppelin's exploits come close to realizing the dream of the French artist GERALD ELLIS CRONIN

Brooklyn N Y

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SHEET LIGHTNING

To the Editor of the SCIENTIFIC AMERICAN

In connection with Mr A A. Graham s letter in the issue of August 28th 1909 I would like to say that the facts at our disposal at the present time would seem to indicate that sheet lightning is to be expected at high altitudes.

First The atmosphere is very rare.

Second It is probable that the atmospheric dust if not wholly lacking is present in but small quantities, of the lightest material.

Third The temperature is low and the clouds are very apt to consist of minute ice crystals.

If it is correct to reason from the laws governing the discharges of an induction coil, we may draw the following conclusions:

Likening the sheet lightning to the so-called spark of the coil, we can safely say that such a discharge is unable, owing to the lack of dust, to form an incandescent path.

If the sheet lightning is compared with the brush discharge of the coil the following facts are brought out:

The rareness of the air would tend to produce sheet lightning.

The action of the crystals [illegible] the same way as a piece of varnished cambric placed between the terminals of a coil.

Such discharges would be noiseless.

In conclusion I would like to ask if any of your readers have satisfactory explanations of the coloring (violet to yellow) of lightning flashes

Pinebur Miss W H DUNN

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LATIN-AMERICAN TRADE

To the Editor of the SCIENTIFIC AMERICAN

Do you know that the total foreign trade exports and imports of the twenty-one republics including the United States in 1907 was $5 500 000 000?

Do you know that of this the share of the twenty Latin American republics was $2 077 000 000?

Do you know that these figures show that Latin America does more than one-third of the total commerce of the American republics divided as follows

Exports to foreign lands	$1 072 000 000
Imports from foreign lands	1 005 000 000

Do you know that further analysis of these figures shows a total foreign trade between Latin America and the United States of $558 000 000?

Do you know that this total represents only about one-fourth of the total foreign trade of the sister republics of the United States divided as follows

Exports to the United States	$318 000 000
Imports from the United States	240 000 000

Do you know that these figures show a balance of trade against the United States of approximately $78 000 000 a year?

Do you know that the Latin American countries bought last year from other nations than the United States $756 000 000?

Do you know that from the United States these countries purchased only $240 000 000?

Do you know that Latin America purchased more than three times as much from other countries as she did from the United States?

This demonstrates the great possibilities of trade development for the United States in Latin America

John Barrett in a speech before the Trans-Mississippi Commercial Congress in San Francisco October 6th 1908 said

Without unwarranted enthusiasm let me point out to you my confident belief that the next ten years will be a Latin American decade—that all the world will be then studying and watching Latin America as it now does Japan and the Orient and that a material economic intellectual and political advancement will be witnessed in Latin America which will rival what has been accomplished in the United States Were it not for the lamentable ignorance which prevails throughout the United States in regard to the peoples institutions resources and governments of this section of America this statement would not seem in the least surprising Those of us who have traveled from Cuba to Chili and from Brazil to Bolivia are keenly aware that this great onward movement has already begun and that Latin America has entered upon a new era of splendid activity and world wide influence

Twenty republics varying in size from the area of Brazil which is larger than that of the United States proper by 200 000 square miles to Salvador the smallest which would take in Rhode Island six times over having a combined population of nearly seventy millions and a foreign commerce valued at more than $2 000 000 000 per annum are going ahead so rapidly that no man can safely prophesy the limit of what they will accomplish during the next ten years Gifted with a variety of climates and of resources blessed with a marvelous intermingling of cool plateaus and tropical lowlands, provided with vast navigable river systems and long extent of accessible coast line supplying numerous important products which the rest of the world must purchase and possessing great mineral wealth and a people of deep sympathies and high intellectuality based on an old and worthy civilization they all challenge our best study and keenest appreciation

I am indebted to the International Bureau of American Republics for the above data

New York, N Y ALFRED J THOMISON

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TREES AS WITNESSES IN EARLY SURVEYING

To the Editor of the SCIENTIFIC AMERICAN

Your very interesting account of Making a Tree to Speak in the issue of the SCIENTIFIC AMERICAN of August 14th is rendered more complex in Pennsylvania than in the West for two reasons First by the system of surveys or rather the lack of system in the early surveys, and second by the fact that they are much older and consequently much harder for a surveyor to determine Throughout northern and eastern Pennsylvania the surveys were made at dates varying from 1745 to 1804 The earliest surveys were isolated tracts, usually taken up by settlers and surveyed by authority of warrants granted by the Proprietors to the applicants and executed by a deputy surveyor to whom the warrant was directed About 1767 explorations were made by agents of the Proprietors of the river valleys and in 1769 large areas were sold to settlers and the lines run and marked upon the ground by what Mr Cooke calls the blazed line or by chopping off a small slice of bark from the opposite sides of the trees which the surveyor passed The corners of the surveys were usually marked by cutting three notches in the corner tree in the direction from which the surveyor approached it and on the side from which he left it Besides this corner tree the surveyor marked other trees standing near by with three notches on the side facing the corner tree and called witnesses These surveys of 1769 were located in the river valleys and generally at the mouth of some stream of considerable size affording abundant water power as it came to the river In 1772 the surveys were extended up the smaller streams sometimes for long distances taking the land which was deemed tillable and this plan was followed until 1789 At this date there arose a great demand for the lands and large bodies were sold by warrants to the applicants who had them surveyed and frequently the surveyor had no regard for the previous surveys and laid the new warrants on top of the older ones In the year 1793 a company known as the Holland Land Company took warrants for thousands of acres located in the northern part of the State and sent surveyors to make the location Again these surveyors paid no attention to any of the former surveys and used the same style of marking as had previously been used by the older surveyors In 1802 to 1804 the surveyors from the State of Connecticut claiming under the original charter granted by the King of England extending from the Atlantic to the Pacific came into the State and began their surveys and again used the same system of marking paying no attention to any of the former surveys This act led to what is termed in history the Pennimite and Yankee war which later by the decree of Trenton decided that the Connecticut settlers should hold seventeen townships in Luzerne County but that the State of Connecticut should release all its claim to other parts of the State of Pennsylvania

Now after the lapse of from one hundred and seven to one hundred and sixty years the surveyor finds difficulty with the full meaning of the word in determining how these old surveys were located The timber in many places was removed before the lines were fully settled and where it remains it requires a great amount of skill on the part of the surveyor to detect the traces of the ax marks in the bark of the trees and still more skill to count the rings to determine to which set of surveys the mark belongs This difficulty is increased by the fact that the old surveyors were careless in their locations and occasionally the marks are found as much as two miles from where they purport to be and the courts hold that the monuments on the ground are the controlling factor in making the location

To show the importance of making a tree speak to determine a location a surveyor recently had occasion to retrace the lines of a survey made sixty years ago The corners were all obliterated Some had been trees some were called stones and one was called a pine knot A dispute arose over the location of the pine knot A surveyor was called and after trying in vain to locate the pine knot from the other corners as called for came upon a marked line tree bearing the date of this particular survey and traced it out until he came to a point where tradition said the other line of the survey came to the pine knot Making search he found a marked tree on that line and bringing the two lines to an intersection on the bearings called for was preparing to set a permanent monument when a workman dug up a piece of wood On examination this proved to be the pine knot in question By removing the accumulation of decayed wood and dirt the notches with which it had been marked were so clearly discernible that the location was settled

Different kinds of timber show a variety of ways of healing over the cut and some become so overgrown in a few years that they are more difficult to determine than some other species after a much longer period The various species of pine lose the marks in a few years where they are of rapid growth because the bark shells off Some species of oak and the hemlock will hold a mark for a long time and frequently it is found that the marks show very plainly after a lapse of over one hundred years In the Connecticut survey above referred to some corners were trees on which Roman numerals were cut and yet after a lapse of over one hundred years the letters can be found in the old wood of the tree by cutting away the new growth which has closed over the flattened surface where the numerals were cut So taking it all, the trees do speak and tell an indisputable story and stand as silent witnesses to the hardships of the surveyors of that early day in climbing over the mountains and leaving their trail in the timber to be found by future generations

Millville Pa BOYD TRESCOTT

COMMANDER PEARY'S DISCOVERY OF THE NORTH POLE

The amazing coincidence of the report by two independent explorers of their location of the North Pole within a year of each other after the hardship privation and expense of life and funds endured in vain in the effort to find it for over three hundred years makes any comparison of the probability of the reports or the value of the results obtained difficult if not unprofitable with the limited particulars hitherto available

We prefer therefore to await the verdict of the investigation which will undoubtedly be made by the highest scientific authorities upon presentation of the complete evidence on either side and expressing no opinion briefly to summarize Mr Peary's report of his achievement as we did that of Mr Cook

The origin and early history of polar exploration was sufficiently outlined in last week's SCIENTIFIC AMERICAN which also compared the reported achievement of Cook with the earlier work of Peary After the later expedition of 1906 when he reached 87 deg 6 min N lat then the farthest north he determined to make one more effort to reach the Pole and the Roosevelt was accordingly equipped by the Peary Arctic Club with all the material and scientific armaments which have been proved to be most essential in polar exploration by Commander Peary's twenty three years of experience

The Roosevelt with Peary and his party on board left New York on July 6th 1908 called at Sydney near Cape Breton Nova Scotia leaving there July 17th and proceeded east round Newfoundland and then straight north through Davis Strait and Baffin's Bay to Cape York Greenland at the southern end of Smith Sound Leaving there August 1st the ship proceeded *via* Etah farther up the sound navigating laboriously through floating ice often densely packed to Cape Sheridan Grant Land the northern end of Ellesmere Land and on the other side of the sound arriving there September 1st and here the expedition passed the winter The farther progress of the explorers has been reported by Commander Peary exclusively to the New York Times, by whose courtesy we are permitted to give the following abstract.

Peary's full report describes greater difficulty in making the point selected for winter quarters than was at first anticipated. An actual landing at Cape Sheridan was not made until several days after arriving there, strong northeasterly winds and the drift of the ice repeatedly forcing the ship back and twice driving her aground, and it was only on September 5th, after zigzagging through leads in the ice for several days, that the "Roosevelt" succeeded in rounding Cape Sheridan into open water and lying up in an opening in the floe at the mouth of the Sheridan River

Supplies and equipment were immediately transferred across the ice to a clapboard house and storeroom hastily built on shore, and on September 15th the work of transporting supplies was begun, several sledge expeditions depositing provisions at various points along the coast from Cape Sheridan to Cape Columbia, so that the sledge party on its spring dash for the Pole might travel as light as possible and pick them up en route This work was carried on continuously until November 5th and was mingled and followed by hunting expeditions tidal and other observations by various parties lasting until February

The sledge expedition for the Pole left the Roosevelt in three divisions on February 15th 21st and 22nd under Capt Bartlett, Prof Marvin and Com Peary respectively the total of all divisions being 7 whites and 59 Esquimaux, with 23 sledges drawn by 140 dogs.

All of the divisions appear to have assembled at Cape Columbia, such of the supplies as were required being brought up from the other depots on the route the dogs rested and the equipment thoroughly overhauled by February 27th In the meantime, apparently Bartlett's pioneer division had been hewing a way north through jagged ice to the big lead, a stream of open water which he crossed on the first of March and got away north over the ice the remainder of the party following soon after but being stopped on their second day's march by open water formed by a breach of the ice by strong wind after Bartlett's division had passed the spot Two sledges were smashed beyond repair in the first march, the teams going back to Cape Columbia for reserve sledges. At the end of the fourth

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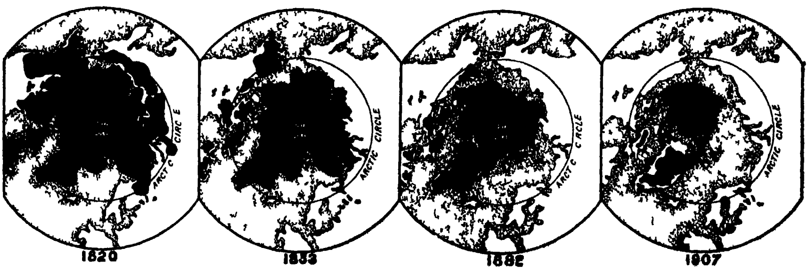
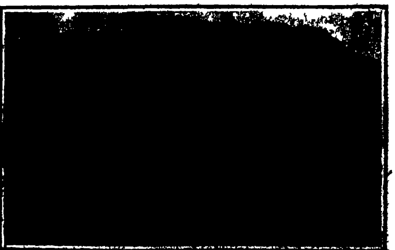
Ex-President Roosevelt bidding Commander Peary God-speed on his successful polar expedition



Four stages in Arctic discovery The black areas indicate the unexplored portions in the respective years.



Photographs by Underwood and Underwood.

Dr Cook in conversation with Etah Esquimaux Some of these tribesmen accompanied him on his successful expedition,

Mr [illegible] Jansen, Danish Inspector of North Greenland, the first to receive the news of Cook's success. He is the man with [illegible]

SCENES ON THE COOK AND PEARY EXPEDITIONS.

day the rest of the expedition caught up Bartlett, who had been stopped by open water, which delayed the entire party till March 11th.

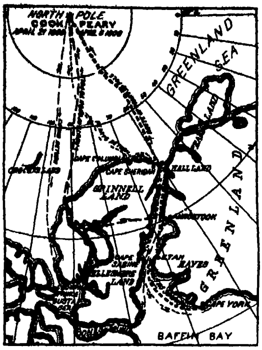
On the 5th of March the sun appeared for a few minutes at noon for the first time after the long winter night On March 11th the lead was sufficiently frozen over to be crossed, and another start was made. Borup and Marvin, who had gone back for alcohol and oil from Bartlett's third camp had not yet come up with the expedition in spite of the delay causing some anxiety but a note was left for them and three days later they caught up the main party at the end of its sixth march The latter in the meantime had been traversing alternately floating solid ice and newly frozen leads, and had just crossed the 84th parallel From that camp Dr Goodsell turned back by prearrangement and McMillan accompanied him reluctantly owing to a badly frozen foot, which he had been concealing for three days much to the regret of Peary who had counted on his enthusiasm and physical powers

The best dogs and sledges were selected for the northward journey the party now consisting of 16 men 12 sledges, and 100 dogs At the end of the tenth march at latitude 85 deg 23 min Borup turned back in charge of the second supporting party The traveling rather improved and Commander Peary and Marvin waited twenty hours after the start of the advance party in order to overtake them as they broke camp after the next halt, thus using the same camp and keeping in touch with the advance party once in every twenty four hours. After two more marches the sun began to get high enough for observations to be made 85 deg. 48 min being recorded and the going continuing to improve 50 minutes was covered in the next three marches including 20 miles on the third day bringing the party to 86 deg 38 min At this point Marvin turned back with the third supporting party The next day's march was good but after that came the deepest snow encountered accompanied by haze which made a short and exhausting journey At the end of the succeeding day the ice parted exactly where the party was encamped nearly causing the loss of dogs and sledges but after an exciting period dashing from one moving floe to another better going was reached Then came Capt Bartlett's last day another long march with fair going camp being made at 87 deg 48 min as shown by observation of the sun next day The sturdy navigator of the Roosevelt who had borne the brunt of the pioneering work walked several miles north in the morning to be sure that he crossed the 88th parallel and then turned reluctantly back with the two Esquimaux of the last supporting party the provisions carried being insufficient to last more than 6 men and 40 dogs for the week or more estimated to be required to reach the Pole as well as for the return journey

Peary then determined to try and reach the Pole in five forced marches allowing less than a day for each, extending the last one if necessary to complete the distance lacking. His cabled narrative speaks of five marches of fifteen miles each but as he was then south of the 88th parallel this is an obvious mistake for 25 miles to which distance he refers as having accomplished his intention on his next the twenty first, march. After a few hours sleep good going was found and twenty miles were covered on the twenty-second march before an open lead delayed the journey Another brief halt and even better weather and smoother ice enabled another twenty miles to be made on the next march including a dash across 100 yards of ice newly formed over a lead which buckled under the sledges and broke as the last one left it Again a short sleep and twenty five miles were made on the twenty fourth march Although the temperature was not so low as had been experienced even the Esquimaux complained of the bitter cold Much needed sleep was taken for a little longer and then the party dashed forward dreading that each rise in the ice marked an open lead but always finding continued going The haze was thicker but an observation was possible at noon showing 89 deg 25 m A rise in temperature to 15 deg below zero encouraged the dogs, and forty miles was covered in twelve hours An observation at noon on April 6th at the end of the twenty sixth march showed latitude 89 deg 57 m to have been reached only three minutes or a little over three miles from the Pole so the remaining distance was apparently covered before a rest was taken

The first thirty hours at the Pole was spent in making observations and taking photographs Ten hours after arrival the weather cleared and the afternoon of April 7th was cloudless A crack in the ice five miles from the Pole was found and a sounding was made 1 500 fathoms of wire finding no bottom and the wire being broken and lost in withdrawing it.

Speed was just as urgent on the return as on the upward journey every day gained lessening the chance of a gale opening leads and destroying the track Every march back lessened the chance of provisions running short before the base was reached so the equipment could be lightened to facilitate speed Peary therefore determined in spite of the records for Arctic travel made on the advance to try to halve the daily journey on the return covering two of the northward marches on each march south and making use of the same igloos —the ice huts made in camping—and so saving time at each halt This he very nearly accomplished regularly covering five outward marches in each three of the return journey He was singularly fortunate in escaping open leads in the ice which had delayed the return of the supporting parties down to lat 85 deg 23 m the camp at the end of the tenth outward march where a lead five miles wide was encountered By good luck Bartlett's trail was found again at the other side and by continued rapid traveling Cape Columbia was reached on the 23rd of April after fifteen marches The Roosevelt was reached in two more marches and found unharmed Nearly two months were spent in additional geodetic observations and in bringing back remaining supplies from the outlying caches until on July 18th the ice was sufficiently open for the ship to be removed from her berth She fought her way south to Cape Sabine by August 8th picked up Whitney and the stores at Etah coaled from the Jeanie and cleared from Cape York August 26th and reached Indian Harbor September 5th to send the now historic telegram Stars and Stripes nailed to North Pole



Map showing the routes taken by Peary and Cook on their expeditions

How the sextant is manipulated in measuring the sun's altitude.

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HOW COOK MADE HIS LATITUDE OBSERVATIONS

So much doubt seems to have been engendered in the public mind by a certain portion of the press regarding the validity of Dr Cook's observations that it may not be amiss to describe briefly the methods which in common with every other explorer he would necessarily adopt in determining his latitude The actual determination of latitude although it is one of the most important practical questions in astronomy is also one of the most elementary for which reason we fail to understand why so much ado should have been made

For the purposes of astronomical measurement the celestial sphere is divided as indicated in Fig 1 Assuming that the observer is placed at *O* his celestial horizon will be *H F S W* The axis of the heavens will be *P p* *P* being the elevated pole and *p* the depressed pole *Z* will be the zenith of the observer and V his

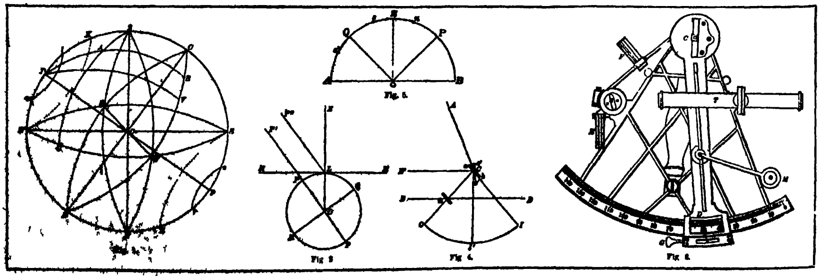


Fig. 5. Fig 3 Fig 4. Fig 2.

Diagram showing the principle of the sextant and the manner of its use in determining the altitudes of celestial bodies.

HOW COOK MADE HIS LATITUDE OBSERVATIONS

nadir The great circle $HZSN$ will be the observer's celestial meridian like all great circles passing through the celestial poles It is an hour circle or circle of declination The circle $EQWD$ is the equinoctial (the celestial equator) and the circle $EZWN$ perpendicular to the meridian is the prime vertical cutting the horizon at E and W, respectively the east and west points The north pole of the heavens is P and is marked by the Pole Star or North Star

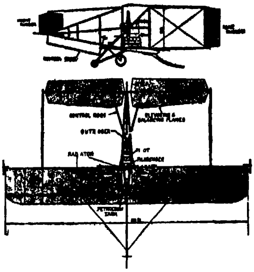
The latitude of any place on the earth is equal to the altitude of the elevated pole at that place Hence by measuring the altitude of the Pole Star the north latitude of a place above the equator is directly obtained This follows from a consideration of Fig 2 in which Pp is the earth's axis and EQ the equator The line HR tangent to the earth's surface at L is the horizon and the point Z the zenith of L Assume that the earth's axis and the line LP parallel to the earth's axis to be both indefinitely prolonged Because of the immensity of the celestial sphere as compared with the earth these two lines will sensibly meet at a common point on the surface of the celestial sphere and this common point is the elevated pole To an observer L this elevated pole will therefore lie in the direction LP' and $P'LH$ will be its altitude From Euclidian geometry we know that the angle HLZ is equal to the angle POQ and the angle ZLP' equal to ZOP Hence the angle $P'LH$ (the altitude of the pole) is equal to LOQ the observer's latitude

The latitude of a place on the earth is also equal to the declination of the zenith at that place The declination of a body or point is its angular distance from the plane of the celestial equator and hence ZOQ in Fig 2 is the declination of the zenith or latitude of L in Fig 2

In order to calculate his latitude the navigator or explorer employs a sextant which is an instrument by means of which the angular distance between two visible objects can be measured Since Pole Star observations cannot always be taken because the horizon is not always visible at dusk or at night time the navigator is generally compelled to measure the sun's altitude and to use that as the basis of latitude calculations As shown in Fig 3 the sextant is a sector of a circle whose arc measures 60 deg A movable radius called the index bar CD revolves about the center of the sector At its lower extremity the bar carries a vernier D At the upper extremity of the index bar is a silvered mirror C the surface of which is perpendicular to the plane of the instrument Another glass A called the horizon glass is rigidly attached to the frame of the instrument the upper half of which glass is transparent and the lower half silvered The surface of the horizon glass must also be perpendicular to the plane of the instrument A telescope T is directed toward the horizon glass with its optical axis parallel to the plane of the instrument. Two sets of colored glasses F and F are usually provided for the protection of the eye when the sun is observed The sextant is constructed on the principle that the angle between the first and last direction of a ray which has been reflected twice in the same plane is equal to twice the angle which the two reflecting surfaces make with each other

Suppose that we wish to measure the angular distance between the sun A and some distant object B on the horizon (Fig 4) The object B is distinctly visible at D in the telescope through the upper transparent half of the horizon glass m. The object B is so distant that the rays BC and BM coming from it may be regarded as sensibly parallel If CI and CI are the positions of the index glass and index bar when both glasses are parallel the ray BC will be reflected by the two glasses in a direction parallel to itself and the observer whose eye is at D will see both the direct and the reflected image of B in coincidence If the index bar be moved to some new position CI so that the ray from the sun A is finally reflected in the direction mD then the observer will see the direct image of B and the reflected image of A in coincidence The angular distance between the two bodies is evidently equal to the angle between the first and the last direction of the ray AC which angle is equal to twice the angle made by the two glasses with each other or twice the angle ICI If then we know the point I on the gradient arc at which the index bar stands when the glasses are parallel twice the difference between the reading of that point and that of the point I will be the angular distance of the two bodies To avoid this doubling of the angle every half degree on the arc is marked as a whole degree

The sun is the body generally used by navigators in determining latitude The time of noon being approximately known the observer begins to measure the altitude of the lower limb of the sun a few minutes before noon and continues to measure it until the sun ceases to rise, or "dips" as it is called. The greatest altitude attained by the sun is taken as the meridian altitude Corrections are made for index error dip, atmospheric refraction, parallax, and semi-diameter and the result is the sun's true meridian altitude. Taking this from 90 deg. we obtain the sun's zenith distance Looking in the Ephemeris or Nautical Almanac we find the sun's declination given for Greenwich (or Washington) noon of every day, with the hourly change so that we can easily deduce the exact declination at the moment of observation. Then the observer's latitude is obtained because the latitude of the observer equals the sun's zenith distance plus the sun's declination This is apparent from a consideration of Fig 5 in which the circle $AQPB$ is the meridian Q and P the equator and the pole and Z the zenith QZ is the declination of the zenith or the latitude of the observer If the sun is observed at s south of the zenith as it crosses the meridian then Zs is its zenith distance and Qs its declination which is known Then QZ equals $Qs + sZ$ in other words the latitude equals the declination of the sun plus its zenith distance



Plan and side elevation of Capt Cody's biplane.

The handling of the sextant is so simple a matter and the application of corrections to its readings so easy that we fail to understand how anyone can seriously doubt Dr Cook's accuracy

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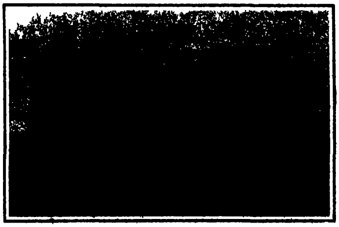
CAPT CODY'S BRITISH ARMY AEROPLANE.

Following close upon the great exhibition of flying which was given recently at Rheims Capt S F Cody who has been working for a number of years in the interests of the British government has met with complete success with his aeroplane and has succeeded in accomplishing a cross-country flight of one hour and three minutes duration, in the course of which he rose to a height of about 400 feet circled a church steeple and traveled altogether about 47 miles. This is the first flight demonstration of any account which has been given in England and the fact that it has been accomplished by an American after persistent experimenting puts another aviation record to the credit of the United States.



Capt Cody in flight in his latest biplane.

CAPT CODY'S BRITISH ARMY AEROPLANE.

Capt Cody has made a few minor changes in his machine since it was illustrated by us in our issue of January 30th last. Chief among these is the dividing of the single-surface horizontal rudder in front of the machine into two separate planes, or wings, placed side by side and arranged so they can be worked together or separately and in opposite directions. This division of the horizontal rudder into two parts has been substituted for the [illegible] ing planes, which were formerly placed at [illegible] of the single surface By [illegible] the present rudder in opposite directions, the machine can be righted when it tips to one side or the other, and this movement of the wings can also be used in steering the aeroplane to the right or the left. Steering in a horizontal plane is accomplished chiefly by means of two vertical rudders—one in front above the horizontal rudder and one some distance at the rear of the planes

The Cody biplane is mounted upon three wheels and one skid Two of the wheels, which are about 2 feet in diameter are placed side by side just under the front edge of the lower plane while the third one is located in advance of the other two and at the intersection of two pairs of heavy inclined uprights extending downward from the rear longitudinal of the upper plane and from beneath the bed of the motor respectively The former pair of inclined uprights carries seats for the aviator and his passenger the latter seat being a foot or more above the aviator's seat and just in front of a radiator consisting of long thin tubes extending upward to the front edge of the top plane A single skid extends backward from the rear edge of the lower plane on the center fore-and-aft line of the machine Most of the weight of the aeroplane is carried upon the two large wheels placed beneath its front edge Coiled-spring shock absorbers surround the upright rods extending from the axle of these wheels to the lower edge of the front plane. If the machine tips downward in front when running along the ground, the weight is taken by the small wheel in front, while if it tips upward the skid at the rear touches the ground This skid also acts as a brake when alighting The use of the inclined uprights extending out in front, and also the use of bamboo to support the rudders makes Capt Cody's biplane somewhat similar in construction to that of his fellow countryman Mr Curtiss.

The main planes of Capt Cody's machine are 52 feet long by 7½ feet in a fore-and-aft direction They are spaced 9 feet apart at the center this distance gradually diminishing to 8 feet at the ends. Both planes are arched slightly in a transverse direction, the upper one being curved downward somewhat more than the lower one in order to bring it nearer to the latter at the ends The ends of both planes moreover are almost flat although the other parts of the surfaces have the usual parabolic curve In arching these surfaces downward Capt Cody has followed the idea of the Wright brothers who claim that a slight downward curvature of the ends of the planes is preferable to an upward curvature of them In the "June Bug" biplane of the Aerial Experiment Association it will be remembered that the upper plane had its ends curved downward, while the ends of the lower plane were curved upward This arching of the surfaces in opposite directions was we believe the idea of Lieut Selfridge and it was found to work very well.

The wings of the horizontal rudder are also arched slightly in a similar manner to the main planes These are operated by a horizontal steering wheel mounted upon the end of a universally pivoted lever Swaying the wheel from left to right or *vice versa* sets the wings of the horizontal rudder so as to right the machine when it tips while turning the wheel moves the vertical rudders in front and behind and also inclines the wings of the horizontal rudder slightly in opposite directions in order to tip the machine downward as it makes a turn; pushing forward the steering wheel or pulling it backward causes the two wings of the horizontal rudder to move together and inclines them downward or upward, in order to direct the machine in either of these two directions Capt Cody has also provided for auxiliary balancing planes at the ends of the main planes. These can be attached to the uprights half way between the planes, if they are found necessary, in order to tip the machine in making abrupt turns. The inventor has also provided for warping the main surfaces if he finds this necessary He has employed a system of warping the wing extensions of box kites for some time past with the man lifting kites with which he has experimented If it was found that the kite was not riding properly by hauling it down and warping the wing extensions of the main box the trouble could be remedied

The power plant of the Cody machine now consists of an 8-cylinder E N V gasoline motor capable of developing about 80 horse-power This motor has replaced the 50-horse-power Antoinette which he used early in the year It has been moved slightly back from the front edge of the lower plane, instead of being placed forward of the front edge [illegible] In other words, the positions of the motor and [illegible] have [illegible]

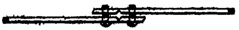
(Continued [illegible])

Handy Man's Workshop

A HANDY TAP WRENCH.

BY EDWARD F [illegible]

A wrench for holding machine taps or reamers and the like can be easily made of a piece of flat steel and two machine screws. If steel is not handy, iron can be used. Take a piece of stock of about ⅝ x ¼ inch, and cut off two lengths of 5 inches each. Near the end of these pieces and about 1 inch apart drill two holes, ¼-inch tap holes in one and clearance holes in the other. Centrally between the holes file V-shaped grooves about 1/16 inch deep. Tap out the holes and assemble the parts, using round head screws of ¾ inch length. The ends of the wrench should be rounded for convenient handling. The dimensions herein given can of course be varied at will. Any size from the smallest to the largest can be made in this way.



A HANDY TAP WRENCH.

◆

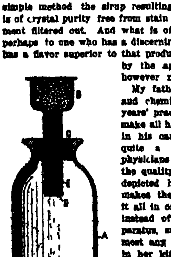
THE COLD PROCESS OF MAKING SIRUP

BY THALBON MIARS, C E

The customary way of preparing table sirup is to pour boiling water on sugar, or set a pan of water on the stove to boil, with sufficient sugar to sweeten and give body to the water. Sirup for canning is almost invariably made by one of these methods, although neither one enables the housewife to obtain a finely-flavored clear fluid.

Sugar when put in boiling water or in cold water that is raised to the boiling point seems to lose its delicate flavor; the resulting sirup is frequently stained, rather faintly yellowish or bluish, according to the composition of the vessel in which it is prepared. This stain may be due to the chemical salts in the water, which are made active to color sugar by being subjected to heat, or the stain comes from the tinned or glazed material of the vessel given off when hot in the presence of water and sugar. It may of course originate from the chemical reactions set up in the water only when the water is in vessels of certain composition, and the stain may be unnoticeable when vessels of other composition are used. But where a stain in the sirup cannot be detected, there will always be found a gritty sediment in the sirup pitcher after cooling. This is due to the impurities of commercial sugar.

There is another and better method of making sirup than by the aid of heat. It is the cold process. By this simple method the sirup resulting has a body that is of crystal purity, free from stain, and with the sediment filtered out. And what is of more importance, perhaps, to one who has a discerning palate, the sirup has a flavor superior to that produced by cooking or by the application of heat, however moderately.



THE COLD PROCESS OF MAKING SIRUP.

My father was a druggist and chemist of near thirty years' practice. He began to make all his sirups very early in his career and obtained quite a reputation among physicians in his locality for the quality of them. I have depicted his method, which makes the sirup and filters it all in one operation, using, instead of the chemist's apparatus, such articles as almost any housewife can find in her kitchen, and can assemble easily.

The parts required in this home-made apparatus are a bottle A of about a quart or more capacity, an Argand lamp chimney B, two corks, C and D, and a bit of cotton E, for a filter. A large-mouthed bottle, having a well-fitting cork, is preferable to a glass fruit or Mason jar, as the cork C is already fitted to it. While cork C is placed on a board or table, the circumference of the Argand chimney is marked on its upper surface, and a hole is cut through the cork a little less than the mark indicates. Care must be taken to cut this hole so that the chimney will fit in snugly. For cutting cork, which, a [illegible] will do, [illegible] a [illegible] [illegible] having a curved cutting edge, is a better tool to use. The smaller cork D is fitted within the Argand chimney and one or more small holes are bored through it; the holes may be burned by means of a red-hot wire.

If a funnel be substituted for the Argand chimney, the large cork C may be dispensed with, and if a bottle is used having a neck that will admit the Argand chimney's long cylindrical tube but not its funnel-shaped base, no cork need be used with the chimney either; but the use of a cork is preferred, as it prevents the dust from getting in and keeps the water in the sirup from evaporating. In use the parts are assembled as shown in the drawing, and pure granulated sugar is poured into the chimney until the tube part is filled. Over this filtered water is poured, and the top is then covered to exclude dust.

Immediately the manufacture of sirup begins. The process must not be hurried. The rate at which the sirup drops into the bottle must be regulated by the size of the hole through the cork D, also the thickness of the cotton E and the density it is packed home against the cork. If the sirup is made too rapidly it drops down diluted. By regulating the filter the control of manufacture is assured. Filter paper of suitable texture for filtering sirups may be substituted for the cotton; a rapid filter paper and cotton would make an ideal strainer to clarify the liquid as it forms and seeks to escape.

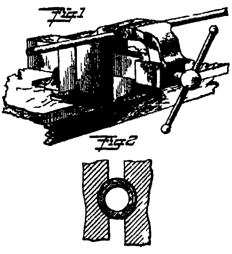
The sirup made by filtration—as a chemist would call the process—has a taste of rock candy. By suspending threads in the sirup, crystals of sugar will grow upon them, popularly known as rock candy. These crystals, by the way, are better than ordinary sugar to sweeten a teacup, in the opinion of some connoisseurs. As a medium in which to preserve cherries, peaches, plums, in fact any whole fruit, to use when serving liquors, it is immeasurably superior to boiled sirup. Cherries hard cooked and suspended in it may be incased in solid crystals of rock candy. With thought and ingenuity many novelties may be devised with it as one of the ingredients.

◆

VISE FOR POLISHED PIPE

BY A T SHARIS JR

A very good way to hold pipe or rods that have a polished surface is to sprinkle dry plaster of Paris on heavy paper and roll the article to be held in the paper, taking care that there is plenty of the plaster between the paper and the pipe or rod. Place the roll between blocks of wood having a hollow face and clamp firmly in an ordinary bench vise. If upon removing the paper the plaster is found to adhere to the pipe in hard cakes, do not try to scrape it off, but wash the pipe in clean water, which will loosen the plaster and leave the surface in a perfect condition. Another method is to place the pipe between pieces of lead sprinkled with plaster and use a pipe vise for a clamp.



VISE FOR POLISHED PIPE

◆

TEMPORARY REPAIRS TO BROKEN SPRINGS.

A spring is most apt to break in the center, as in Fig. 1. The spring clips A A will probably hold it together after a fashion, but the ends will sag and put a dangerous strain on the clips. A hard wood board B, from 1 inch to 2 inches thick, should be procured and the sides trimmed down so that it will be about 5 inches wide in the center and 2 or 3 inches wide at the ends. Drive nails C C in the ends of the board, jack up the frame of the car to take the weight off the spring, put the center of the board on the rubber bumper D, or, if there is no bumper, on a suitable block of wood, and bind the ends down tightly to the spring with leather straps or clothesline.

In case the breakage is toward one end, a block E, Fig. 2, should be nailed to the board over the break. The remainder of the operation is substantially as shown in Fig. 1. When clothesline is used, the winding should start at the end of the board, the short end of the rope being tied in a single knot and led along the board and covered by the subsequent turns.

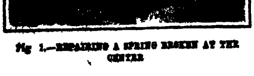


Fig. 1.—REPAIRING A SPRING BROKEN AT THE CENTER

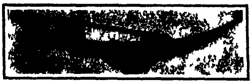


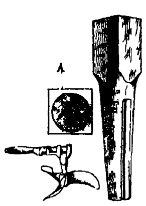
Fig. 2.—REPAIRING A BREAK AT ONE END OF THE SPRING

◆

SIMPLE TAPERED REAMER

BY ALBERT F BISHOP

A simple tapered reamer for fitting a propeller wheel to a shaft that might have an odd taper may be made out of a tough piece of hickory turned in a lathe to the same taper and size of the shaft. Leave a square end on the hickory piece as shown in the illustration. Cut a quarter-inch groove full length in the tapered part, snugly inserting a quarter-inch square piece of steel in the groove. Self-hardening steel is perhaps obtainable. Be sure to bevel the cutting edge, which is marked A in the illustration, to prevent the cutter from digging in. The steel is backed up with three set screws, which may be turned with a screw driver to slightly adjust the taper and make a perfect fit. Use a fair-sized monkey wrench in rotating the reamer. The writer fitted a propeller wheel in a few minutes with this device.



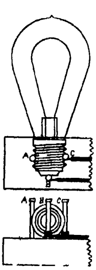
A SIMPLE TAPERED REAMER

◆

A CHEAP LAMP RHEOSTAT

BY F I N [illegible] JR

A lamp rheostat is sometimes required for experimental purposes when receptacles for the lamps are not available. Where they are watched sufficiently to avoid any danger from fire, Edison base lamps may be held in place by nails, thereby overcoming the need of receptacles. The illustration shows such an arrangement, in which a lamp is held in place on a board by three nails A, B, C. No dimensions are given for the location of the nails, as their proper position is very readily obtained by using a lamp as a gage. The edge of the board should be about at the junction of the base to the globe, as shown. See that the nails for holding the various lamps are so located that the globes do not crowd one another. The wires are connected to the nail B and to either A or C. They are twisted around the nails and may be soldered there to if desired. When in use the board should be laid on a table somewhat larger than itself and with the lamps in a horizontal position. In case a lamp accidentally becomes loose, the table will catch it and prevent its being broken. The lamps are inserted by pushing them downward between the nails A and C and screwing them up until contact is made with the nail B. Notice that with certain connections a short-circuit will result if the shell of the base touch the nail B at the same time that it touches C.



A SIMPLE LAMP RECEPTACLE

CAPT CODY'S BRITISH ARMY AEROPLANE.

(*Concluded from page 198*)

two-bladed propellers in opposite directions by means of sprockets and chain. These propellers, as noted in our former article, have blades which taper toward the tips, the widest part of the blade being at the hub Another interesting point about these blades (which are made of aluminium) is that the arms which carry them are fastened to the rear or pressure side of the blades. These arms are inclosed by a false face, in order to avoid sharp angles, but there is a high ridge down the face of the blade, which is so great that the blade has in reality a triple curved face. From the cutting edge to the center the camber increases the pitch, then comes the reversal of the curve, where the false face rounds the arm, and finally a renewal of the sharp camber where the false face runs off in to the trailing edge The propellers are said to give a thrust of over 20 pounds to the horse-power

The weight of the Cody biplane complete with the aviator is about 2,000 pounds. Despite the fact that it is such a large machine, it has been designed with a view to ready portability The main planes each divide into three sections, consisting of a central portion 20 feet in length, and two end portions each of 16 feet in length. The poles which support the rear rudder fold back against the planes, and the front rudder bamboos can be readily dismounted The chassis also comes apart, and thus the whole machine can be easily and quickly dismounted for transport Although no test has been made of its speed, this machine because of its powerful motor and efficient propellers, and, especially, because Capt. Cody has attempted to reduce all head resistance to a minimum, is undoubtedly a very fast one. It is probable that it will compete with the Bleriot and Antoinette monoplanes which are to race in England for a $25,000 purse next month

For the details and drawings of the Cody biplane published in this article, we are indebted to the English weekly Flight.

◆

Aviation Abroad.

The second foreign aviation meeting, which was held last week at Brescia, Italy was by no means as successful as the first event at Rheims. The field was very rough, which made landing without breakage difficult, and in addition to this the weather was not always propitious. M Lefebvre, the daring French aviator who piloted a Wright biplane at Rheims was killed at Juvissy on September 7th when his machine plunged to the ground This is the second fatal accident which has occurred with a Wright aeroplane Lieut Calderara, of the Italian army, who also had a bad fall in his Wright machine a couple of months ago, again came to grief when he took Lefebvre's place at Brescia on September 8th, the first day of the meeting Just after starting the aeroplane tipped so badly that one runner struck the ground and was demolished M Bleriot struck a tree and broke his propeller Anzani's propeller also broke while he was attempting to make a test flight. Both the latter accidents were attributed to the unevenness of the ground Curtiss and Bleriot crossed the startling line every day in the 31 mile race for the Grand Prix according to the regulations, but no extended flights were made up to the time of our going to press. It was much too windy on the 10th instant for any flight to be made At Berlin Orville Wright continued to make daily flights. On September 7th he flew for 52 minutes, and on the 9th he made two flights for Crown Prince Frederick He is teaching Capt. Englehardt to operate the machine. At Scarborough Beach, near Toronto, Can., Mr C F Willard last week made two excellent flights out over Lake Ontario with the Curtiss biplane of the Aeronautic Society Each time he started by running down an incline on the shore of the lake, and made a circle from one to two miles in circumference, landing in the water successfully upon floats fitted to the aeroplane. This is the first time a motor-driven aeroplane has been fitted with floats and made to alight without damage upon water

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RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

SHIRT-COLLAR.—J DORF, New York, N. Y The collar is of the turn-down type, arranged to permit the wearer to conveniently slide the necktie in the collar to the desired position, the necktie not coming in contact with the rear collar button but passing over a flap overlying the collar button and forming an integral part of the turn-down portion, permitting the wearer to draw the collar tight in front by the necktie, causing the collar to appear with a lock front and keeping the top edges close together.

Electrical Devices.

BATTERY-COVERING.—G E. ANDREWS, Providence R I The more particular purpose of the inventor is to provide a two-part covering made of rubber, and provided with means for rendering a battery cell so completely water tight that the cell may be effectively employed where moisture is excessive, or even be totally submerged under the surface of water

SWITCH HOOK-CONTROLLING DEVICE.—M M KAHN, Louisville, Ky In operation, the weighted arm normally rests upon the hook or weight. When, however, the telephone is in use, the arm is thrown backwardly into position, and may be secured in this position by means of the set screw After the telephone has been used, the arm is again turned forwardly into engagement with the hook.

Of Interest to Farmers.

PLANT PROTECTOR.—E. R. DRAKE, De Land, Fla. In growing some vegetables, and particularly tomatoes, and especially in southern latitudes, great care is necessary in controlling access of the sun's rays to the plants so as to graduate their effect to a certain non injurious degree The north side requires no such protection as the others, but being open it allows free access for setting the plants and for weeding, and otherwise tending them while growing

BEET HARVESTER.—M J ELY Oxnard, Cal An object here is to provide a device in which the plow can be raised or lowered and locked in either position so that when the digger is being used and the plow is locked in its lowered position, it cannot be lifted therefrom without lifting the entire weight of the whole frame of the machine together with the wheels and the weight of the driver

THRESHING MACHINE.—T S HAYNES Bay City Texas The invention has in view a rigid frame arranged at one side of the harvester and adjustable to different elevations above the ground, the frame carrying the harvesting mechanism and braced intermediate its length by the frame of a downwardly and outwardly inclined elevator

Of General Interest.

CARD-INDEX CASE.—F. A YUNGEL, New York, N Y In this index case it will be impossible to place a card out of its correct position and the invention may be broadly defined as consisting of a card holding receptacle, with the bottom thereof having card-engaging members located in relatively different positions for each card or set of cards the case is to contain and without interruption between adjacent members.

EYE-SHADE.—G E. HENRY, Philadelphia Pa. This improvement has reference to eye shades of the kind mounted upon spectacles, the more particular purpose being to support the shade upon the end portions of the spectacles, and also to produce certain changes in construction of the shade and its support, thereby increasing the general efficiency of the device.

Hardware.

SELF HEATING SOLDERING-IRON.—A. HUSSON Oshkosh Wis The object of the invention is to produce an iron which will operate effectively to produce a thorough vaporization of the liquid as it is admitted to the burner The invention relates especially to the types of irons which are heated by liquid fuel

WIRE STRETCHER.—F STANLAKE Owosso, Mich. This invention pertains to improvements in stretchers, and more particularly to that type in which there are employed a ratchet member and a pivoted lever member having dogs in engagement with the ratchet member and having its pivot movable longitudinally of the ratchet.

Heating and Lighting.

HOT WATER HEATER.—R. B. SADTLER, Richmond Va In the present patent the invention is an improvement in hot water heaters and it has for its object the provision of a simple and effective structure which will be durable in operation and which will not easily get out of order or leak and will produce a maximum heating effect in operation.

BOILER.—C E. CHAPMAN Fort Edward, N Y A purpose here is to provide a stationary flash boiler in which the steam dome and water column are removed from and are practically independent of the boiler proper, and wherein the amount of water [illegible] by the boiler from the water column by steam air pressure in the water column over that above the boiler pressure is under complete control.

GAS-LIGHTER.—W D. C. WRIGHT, Philadelphia, Pa. A spark coil and battery cells are disposed in a casing, to which is attached a hollow standard, at the top of which there is a stationary electrode and also a spring electrode, the latter being attached to an electrical conductive rod held in bearings in the hollow stem. The casing is of conductive metal and the rod is in electrical communication with the casing. Means provide for completing the circuits.

Household Utilities.

LIQUID STRAINER.—M ARRUBARRENA, Cienfuegos, Cuba The principal object the patent has in view, is to provide a continuously acting filter for sugar syrup, which may be operated with the minimum of power and readily cleaned. Throughout the whole of the construction, the material used is perforated, and therefore filtration is not arrested at any point.

Machines and Mechanical Devices.

CLUTCH.—J SCHNEIDER, Ann Arbor, Mich. In the present patent the invention relates to clutches, and it has for one of its objects the provision of one which will permit of the ready engagement of the drive and driven shafts, with automatic means which will more securely connect the two shafts should there be any slip from the wearing of the parts after the clutch has been thrown into operative position.

CARD-EXHIBITING DEVICE.—A. J THOMAS, Roubaix, S D Means are here provided for conspicuously displaying illustrated postal cards, or cards whereon fancy buttons or like merchandise are placed. The invention affords an apparatus of great capacity and extremely well adapted for the exhibition of cards in large number and of different design, that are brought into view by manual operation of the machine

POT FEEDER FOR TYPE-CASTING MACHINES.—L. A. SENGELE, Victoria Texas. In this instance the invention relates to typesetting and type-casting machines, and more particularly to such machines as are employed to cast slugs provided with impression characters, each slug representing the line, or its equivalent, to be printed.

CENTRIFUGAL BOLTING-MACHINE.—G CUSSON Chateauroux, Indre, France The invention has reference to an apparatus suitable for use in a flour mill as a flour extractor for the different grindings of wheat as an extractor of semolina, oatmeal, or groats as a meal-sifter, and capable also of being used in various industries.

Prime Movers and Their Accessories.

BOILER FLUE CLEANER.—J WIECHMANN, Albany, N Y In this case the object of the inventor is to provide a new and improved boiler flue cleaner, arranged to insure a thorough removal of scale and to provide the desired flexibility of the cleaner to readily pass through bent or curved tubes, flues, or pipes.

INDICATOR.—C W SNYDER Hudson, N Y The improvements are in indicators adapted for use in connection with engines, for making indicator cards to show the variations in the pressure in the cylinder during the movement of the piston. It is especially adapted for use with internal combustion engines.

Railways and Their Accessories.

GRAIN CAR DOOR.—P J A SCHROOR Holstein Iowa. This door is intended to meet the several requirements in loading or unloading grain and can be conveniently manipulated to form openings of more or less extent according to the use to which the car is to be put It may readily be attached to the door of an ordinary car

DUMPING CAR.—T LAWSON, New York, N Y This invention pertains to dumping cars admitting of general use, and particularly railway cars of the general type described in a former patent granted to G I King and T Lawson. The object of the present invention is to improve the general construction of the car, and especially of the means for tilting the box and opening the doors thereof

MAIL-BAG CATCHER.—D. W COUNCIL, Rutherfordton, N C The object of this patent is to provide a device which may be applied to the car without any changes in the same, which will take the bags from the crane or support already in use, and hold it until it is removed from the holder, and which will deliver the outgoing bag, at the time it receives the incoming one

Pertaining to Vehicles.

VEHICLE-SPRING.—J N BASWELL, New York, N Y The invention refers to carriages, road wagons, trucks and like vehicles, and its object is to provide a spring, arranged to yieldingly support the vehicle body and to readily compensate for the variation of the load, without danger of breaking the springs and without requiring the heavy multiple leaf springs now generally employed.

HARNESS.—D. J P [illegible], Greenville, S. C. An object in this [illegible] is to provide a simple harness for detachably securing a draft animal to a vehicle, by means of which the horse or other draft animal can be [illegible] secured to the vehicle, and which [illegible] the horse to be instantly released [illegible] ily without the driver having [illegible] the vehicle.

CARBURETER FOR INTERNAL-COMBUSTION ENGINES.—P. J. [illegible] and [illegible], [illegible], 71 Rue du Moulin Vert, Paris, France. The object of the invention is to obtain an additional supply of air in a carbureter, which is automatically operated by the vacuum which is created in the carbureter by the suction of the motor and to permit of varying the proportions of air and of carbureting fluid according to requirements by using the vacuum itself.

Designs.

DESIGN FOR A BADGE.—J W. GEIGER, Los Angeles, Cal. The badge has the shield form with a beaded border Inside of this the flat surface is ornamented with a clock face at the top placed between the outspread antlers of a deer on whose collar are the capital letters B P O. E. A small flower is on each side of the animal's head at the lower corners.

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INDEX OF INVENTIONS

For which Letters Patent of the
United States were Issued
for the Week Ending
August 31, 1909,

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Abnormal potential discharging and arc disrupting device Erickson & Lord, [illegible]	[illegible]
Acid making apparatus, sulphuric F J Falding	[illegible]
Adding machine J H [illegible], Jr	[illegible]
Advertising apparatus, C. F De Soria	[illegible]
Advertising apparatus for cars, etc J Crane, Jr	[illegible]
Advertising device, automatic dental, Lavallee & Constantineau	[illegible]
Air brake appliance, safety railway track J L. Bering	[illegible]
Airship, E. S. & W D. Le Fevre	[illegible]
Airship, J Muckle	[illegible]
Airship, J A. [illegible]	[illegible]
Albumen and animal casein and the product therefrom, treating vegetable, F. G. Wiechmann	[illegible]
Alfalfa cutting machine, D. L. Adelsperger	[illegible]
Ammonia from coal gases, recovering, F J Collin	[illegible]
Amusement apparatus, H. N Ridgway	[illegible]
Annealing furnace with inlet sealed by steam C. C. Baldwin	[illegible]
Antiseptic composition containing phenyl acetate N. [illegible]	[illegible]
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Bag filling machine, J L. [illegible]	[illegible]
Bag tie, J. M. Stryker, reissue	[illegible]
Baggage records, manifold sheet for, W Leach	[illegible]
Baling machine, E. A. Caswell et al	[illegible]
Ball carrier, J. T. Cowley	[illegible]
Base ball, [illegible]	[illegible]
Basket, folding, W. A. [illegible]	[illegible]
Batteries, container for secondary, [illegible] Oppermann	[illegible]
Battery covering, G. E. Andrews	[illegible]
Bearing, roller, J. H. [illegible]	[illegible]
Bed, folding, J. [illegible]	[illegible]
Bed or couch, extensible, J. Ludwig	[illegible]
Bed pan, [illegible]	[illegible]
[illegible]	[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible], J. B. [illegible]

[illegible]

[illegible] for [illegible], W. L. Johnson

[illegible], C. [illegible]

[illegible], E. P. Palmer

Building construction in [illegible], the [illegible] of [illegible], J. A. [illegible] [illegible]

Burglar alarm, explosive, [illegible] [illegible]

Burner, C. & [illegible] [illegible]

Button blank distributing machine attachment, J. De Francisci [illegible]

Calendar, [illegible] for, C. P. Downing [illegible]

Call box, J. A. [illegible], Jr [illegible]

Camera, W. F. Folmer [illegible]

Can making or lacquering machine, J. G. Hodgson 932,609

Can lacquering or coating machine, J. G. Hodgson 932,610

Can lacquering or coating machine, C. E. Ruskin [illegible]

Canned goods sterilizing apparatus, A. Mill [illegible]

Candle [illegible] machine, C. E. Manbeck [illegible]

Car, J. M. Trueyman [illegible]

Car [illegible], hopper, A. Becker [illegible]

Car brake mechanism, C. M. McCarthy [illegible]

Car door lock, freight, L. Wadsworth [illegible]

Car door operator, Dietrich & Seeley [illegible]

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[illegible], O. E. Reid [illegible]

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Coupling, E. Johnson [illegible]

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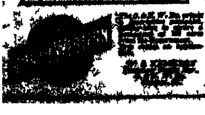
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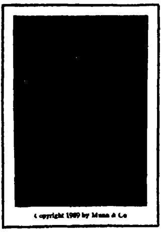
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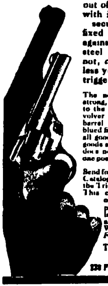

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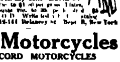

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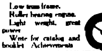

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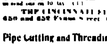

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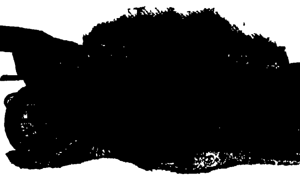

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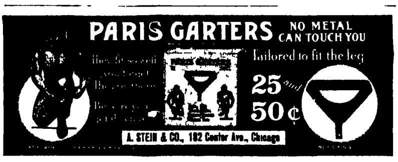

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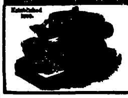

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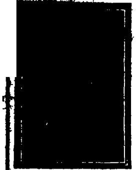

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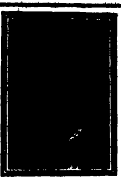

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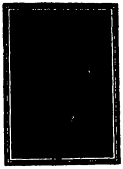

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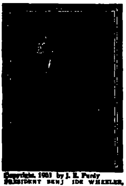

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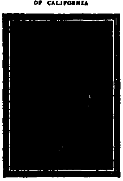

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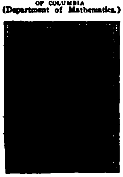

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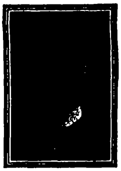

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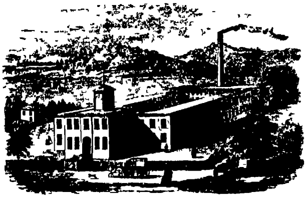

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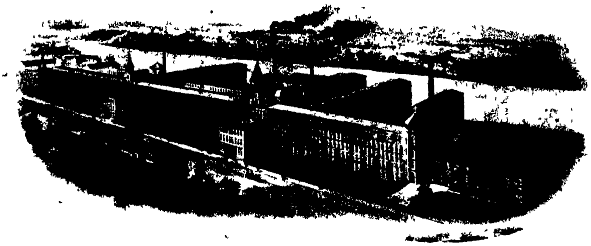

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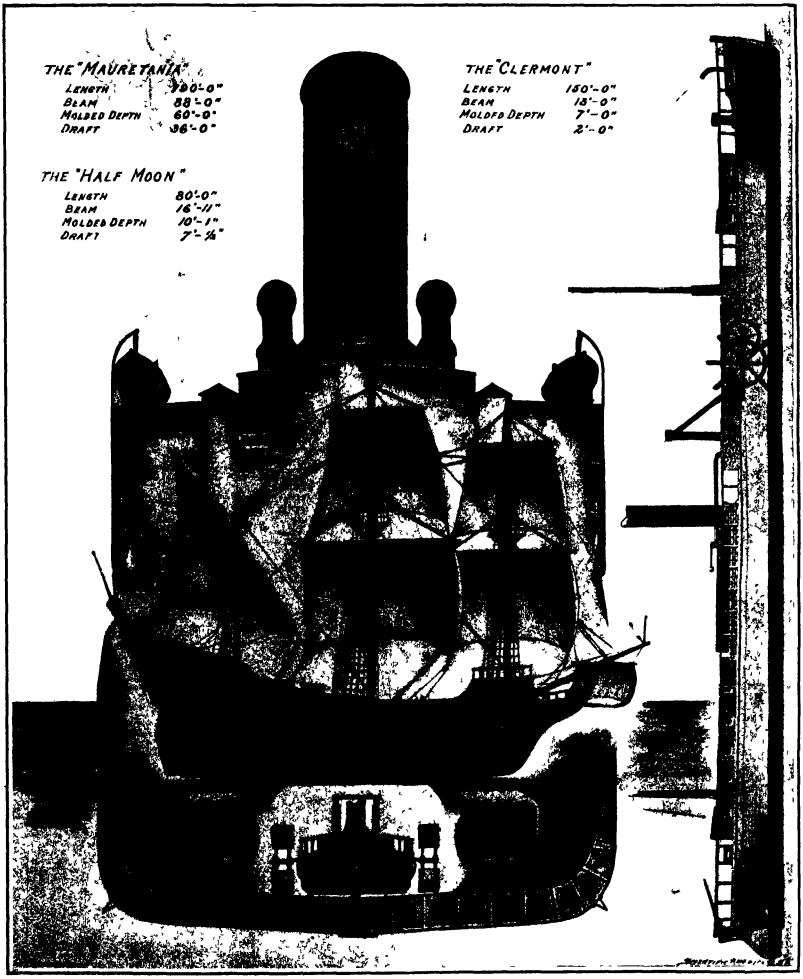

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short* and the facts *authentic* the contributions will receive special attention Accepted articles will be paid for at regular space rates

THE "WASH" OF AN AEROPLANE.

Those of our readers who have sat in a racing shell or stood at the wheel of a racing yacht will remember how troublesome is the "wake of a competitor whether it takes the form of the wash of his sculls or of the disturbance of the air as it sweeps from the leach of the mainsail of a weatherly yacht that is eating out to windward some distance ahead In the case of two racing yachts that are thrashing it out on the same tack in a struggle to windward there is a certain relative position of the two in which the disturbance of the air caused by its passage over the sails of the leading yacht will prove exceedingly troublesome to the second boat especially if she be but a few lengths astern and sailing close to the wake of the other When this occurs, there is nothing for it but to put about on the other tack and so get clear of the interference

With the rapid development of mechanical flight, the remarkable extent of which was shown so clearly in the recent brilliant performances at Rheims it has become evident that the wash, or interference which is inconvenient to a sailing yacht, may become positively disastrous to that yacht of the air the aeroplane It was not until the Rheims contests that an opportunity was presented to determine the effect of one aeroplane upon another when in meeting or over taking they passed in rather close proximity It is quite possible that the question of interference had never occurred to the aviators at Rheims, but it is certainly a surprising fact that the existence of such interference and its evidently serious character as shown when several machines were in the air at once should not have excited more attention both at the time and in subsequent export discussions of the Rheims contests

When such a large body as an aeroplane spreading several hundred square feet of surface and weighing from a quarter to half a ton is driven at fifty miles an hour by propellers that are revolving at from 1 000 to 1 200 revolutions per minute it is certain to leave in its wake a complicated series of aerial cross currents, whirlpools, and vortices Now, judging from the description of eyewitnesses of the Rheims races, the behavior of the aeroplanes when they swept into rather close proximity to one another, indicates that these artificially-created wind storms were present and that they seriously affected the equilibrium of any aeroplane that came within their influence The "wash" from propellers, driven as in the case of Bleriot's monoplane by an 80-horse-power engine and the air waves set up by the passage of his planes must be very serious indeed certainly the air will not regain its equilibrium until long after the machine has swept by

Two notable instances of this interference occurred when several aeroplanes were in the air together During one race when Farman was rapidly overhauling opponents who were flying at the same level, he encountered the wash of the machines and his own aeroplane was thrown into rather violent oscillation Before he could pass it was necessary to make a wide detour to the right or left or swing up to a higher level into undisturbed air On another occasion when Latham flying high overtook a competitor who was traveling at a lower level it was noticed that his own aeroplane made a sudden dive, as though drawn downward by the suction of the machine below him

We attach no little importance to a question which must become increasingly serious as the number of flying machines is multiplied, and the favorite lines of travel become populous with these mechanical birds of the air 'Leeway," as the sailors call it, will become even more necessary to the air yacht than it is now to the sailing yacht Woe to the aviator who, flying low with scant clearance between himself and the ground is overtaken by some aeronautical scorcher who sweeps up from behind, and with the characteristic snort of triumph whirls onward giving him his aerial dust. Happy for him if he recover his rudely-disturbed equilibrium at the expense of a broken wing and not of a broken neck Perhaps after all we have been a little too 'previous" in felicitating ourselves upon the unlimited room that will be afforded for flight through the air, evidently the clearance demanded by our sixty-mile-an-hour aeroplane must be measured by something far wider than the stretch from tip to tip of the planes or the length from head to tail

THE RETURN OF HALLEY'S COMET

The announcement by Prof Max Wolf that he has discovered Halley's comet will be received with interest and with surprise by every astronomer throughout the world—with interest because not a little credit redounds to the Heidelberg astronomer, when it is considered how much this honor has been coveted, and with surprise because the historic comet has made its appearance nearly four months before it was expected

Halley's comet is unique because it was the first celestial body of its kind which was mathematically subjugated to the law of gravitation and because its history is to a large extent the history of astronomy In 1682 a comet was observed by Newton, Halley and others On examining the circumstances of its motion, Edmund Halley who was Newton's intimate friend and who did perhaps more than any other astronomer of his day to popularize the idea of gravitation computed its orbit on the supposition that it was parabolic Comparing his results with the observations of previous comets for which purpose it was necessary to calculate their orbits from the necessarily imperfect measurements of earlier times, he found that in 1531 and 1607 comets had appeared which followed so nearly the same path that he ventured to assert its identity with them and to predict its return within a period of about 75 years. Knowing that he would not live to witness the event because of his advanced age he left a plea for recognition which reads Wherefore if it should return according to our predictions about the year 1758 impartial posterity will not refuse to acknowledge that this was first discovered by an Englishman

In the year 1758 the French astronomer Clairaut took up the task of computing the perturbations which the comet would probably have experienced since its last appearance because of the influence of the two great planets, Jupiter and Saturn An extremely laborious calculation showed that the comet would have been retarded about 100 days by Saturn and about 518 days by Jupiter, and accordingly he announced to the Academy of Sciences near the end of the year 1758 that the comet might be expected to pass its perihelion about April 13th of the following year and that owing to various defects in this calculation, there might be an error of a month either way The comet was actually discovered by an amateur George Palitzsch, on Christmas day 1758 thereby justifying Halley's brilliant conjecture adding a new member to the solar system and raising the hope (to be later amply fulfilled) that in other cases also the motions of comets might be reduced to rule. Thus at one fell stroke the dreadful divinity that once hedged a comet the badge of pestilence of war, and of death, was swept aside for all time

Since Clairaut's day Halley's comet has been made the subject of much mathematical inquiry The French astronomer Pontécoulant carried the calculation of the perturbations back to 1531 and recently Messrs. Cowell and Crommelin of Greenwich have traced the comet back beyond the Christian era The result of these computations has been to prove that Halley's comet undoubtedly appeared in 1066, and was promptly regarded by William the Conqueror as an omen of victory for his English invasion, and that it is the same which is depicted on the Bayeux tapestry In 1378 and 1456 it appeared again Constantinople was besieged by the Turks in 1456, and the comet was regarded by the Mohammedans as a favorable sign because of the crescent-shaped tail. Christendom was so alarmed at the simultaneous apparition of the Turk and the comet that a Papal Bull was promulgated against both In a measure, therefore, the history of Halley's comet is the history of civilization.

The problem of predicting the return of such a body as Halley's comet is one of considerable difficulty If the sun and comet alone existed in space, the path of the comet could be determined easily There are also planets to be considered, and these have a marked perturbing effect.

So variable are the features of the comet, that in all the recorded instances of its return the descriptions never quite tally In 1066 it created universal dread throughout Europe In 1145, according to the Chinese, it had a tail 10 degrees long In 1222 it is spoken of as a fine star of the first magnitude with a large tail. In 1456 it occupied a space nearly 70 degrees in length, and spread terror throughout Europe during the month in which it was visible On the other hand, in 1531 and 1607 it does not appear to have been so conspicuous, for its tail was only 7 degrees long. In 1682 the comet attracted little attention except among astronomers, the tail being 12 to 16 degrees long. This apparent waning of the comet led to the fear that in 1758, the year of its first predicted return, it might be so faint as not to be visible at all In truth, the tail was not visible until after perihelion, and was then inconspicuous because at its brightest it was seen against bright twilight In 1835 the comet was visible to the naked eye during the whole of October, and its tail varied from 20 to 30 degrees in length So marked have been the fluctuations, that there is some question whether the comet will be as magnificent in 1910 as it was in 1546 or whether it will be as insignificant as it was in 1607

Halley's comet never reappears with clock like regularity The change in period from one revolution to the next in some cases has amounted to more than two years. The longest revolution so far recorded was that from 1222 to 1301—79 years and 3 months. The shortest round is the one now being accomplished in a little less than 75 years and 5 5 months. This extreme range of over four years in the orbital period renders necessary the most careful and laborious calculation of the effect of the attraction of all the planets upon the comet. It is indeed marvelous that mathematicians have come so near to predicting the exact date of perihelion at previous appearances. The best calculation hitherto made was that of Pontécoulant, who was only two days out of the way, an achievement which is not likely to be outdone by mathematicians of our time In 1864 Pontécoulant published the results of his calculation of the present return and placed it early in May 1910 a result with which the observations of Cowell and Crommelin agree. Their reservation that possibly the comet may be at perihelion a few weeks sooner is amply justified by Wolf's early discovery At present the comet is about 250 000,000 miles away from the earth At the beginning of November its distance should be not more than 165 000 000 miles

It is certain that if May 10, 1910, is the date of perihelion the comet will be disappointingly near the sun so that the solar glare will rob it of its principal glories.

THE SELDEN PATENT CASE.

The decision which has been handed down in the United States Circuit Court upholding the Selden patent will be received with mingled surprise and disappointment. We are probably safe in stating that few patent lawyers ever believed in the validity of the patent If the defendants carry out their intention of appealing, it is not impossible that the decision will be reversed

The Selden patent was granted on November 5th 1895, to George B Selden Originally filed on May 8th 1879, its final allowance was postponed until the birth of the automobile industry by delaying the filing of amendments The chief claim in issue was "the combination with a road locomotive, provided with suitable running gear, including a propelling wheel and steering mechanism, of a liquid hydrocarbon gas engine of the compression type, comprising one or more cylinders, with suitable fuel receptacle, a power shaft connected with and arranged to run faster than the propelling wheel, an intermediate clutch or disconnecting device, and a suitable carriage body adapted to the conveyance of persons or goods, substantially as described" In other words, George Selden claimed all of the essential features of a modern automobile Every one of the features embodied in this claim was individually old If they were patentable in combination as a road carriage, was a new result produced? We doubt it. The internal-combustion motor was known before Selden's day So were power shafts connected with and arranged to run faster than the shafts or wheels which they propelled So were intermediate clutches or disconnecting devices between shafts running at different speeds.

Thus far, the patent has consumed nine years of litigation, almost half a million dollars, and 60,000 folios of testimony to provide material upon which to base a disappointing decision The Selden patent expires on November 5th, 1912 It may be doubted whether its validity will be finally settled before it expires, if an appeal is taken.

That the patent was ever respected by the automobile industry is due largely to the fact that it was cheaper to pay the slight royalty demanded by its owners than to contest its validity

ENGINEERING.

It seems that unless the new cyanamide industry should create a big demand there is a possibility of an overproduction of calcium carbide. It is estimated that the yearly demand is 192,000 tons. According to Mr Pitaval, the French output last year was 26 000 tons as against a maximum capacity of 50,000 tons. He estimated that the carbide factories of the world have an aggregate of 367,000 horse-power

According to official Canadian railway statistics for the year 1907, the United States has a population of 381 for each mile of railway, and Canada 389 France has 1,590 for each mile of railway, and the United Kingdom 1,821 In India there are 10 119 people for each mile of railroad. In the United States there are 13.61 square miles of territory for each mile of railway, in Canada 161 8 square miles, in the United Kingdom 5 29 square miles, and in France 8 46 square miles for each mile of railway

The proposed Forth and Clyde Canal has been criticised in the House of Commons on the ground that its cost of $20,000 000 will be out of all proportion to its subsequent value Admiral Campbell in reply lays emphasis upon its great strategic value as affording a quick means of transit of warships from the North Sea to the Atlantic and *vice versa* In view of the recent construction of a powerful naval base on the Firth of Forth the importance of such a canal outside of its commercial value has been greatly increased

In view of his classic experiments of twenty years ago and his construction of a gigantic aeroplane the announcement that Sir Hiram Maxim has built a new biplane cannot fail to arouse much interest in the world of aeronautics. The most valuable feature of his work was the determination of the best form of propeller by means of a whirling arm Outside of the fact that his new motor (which, together with the rest of the machine has been built by Messrs Vickers Sons & Maxim) is extremely light in proportion to its power no particulars regarding the machine have been made public

The proposed method of driving ships by the combination of steam turbine and motors, which at first was received rather coldly is now beginning to receive the attention to which we consider it to be well entitled In a recent discussion of the subject in Cassier s Magazine the advantages of the system for cargo boats are stated as follows More cargo can be carried, coal consumption is less there is greater propeller efficiency in rough weather and less propeller racing, and the vessel is not totally disabled if the rudder or a propeller shaft is disabled The disadvantages are that the first cost of the ship is greater and that a more skillful staff is required

At the recent meeting of the British Association for the Advancement of Science at Winnipeg interesting papers were read by Sir John Thornycroft on 'Hydroplanes or Skimmers' by Mr C B Smith on The City Hydro-Electric Plant" of Winnipeg, by Lieut -Col W P Anderson, Chief Engineer of the Department of Marine on Improvements in the Navigation of the St Lawrence', and by Col. G W Goethals chief engineer and chairman of the Isthmian Canal Commission on "Engineering and Construction Features of the Panama Canal" The latter was considered the most important paper and will appear in full in the Association s Proceedings, only one paper in each section so appearing

Two of the largest lighters afloat have recently been launched by Messrs. Rennie of Greenwich England They are entirely constructed of steel, 112 feet long 30 feet beam, and 11 feet 9 inches deep with a draft when lifting 500 tons of 10 feet. They are divided for 66 feet of their length by a well on either side of which are six separate water-tight compartments any or all of which can be quickly flooded for balancing, while they may be expeditiously cleared by a powerful steam pump. The quarters for captain and crew are forward, and boiler and engine room aft The lighters have been built to the order of the Mersey Dock and Harbor Board, and are intended primarily for raising sunken vessels and similar objects

The Metropolitan District Railway of London and its associated underground lines are subjected to a destructive wear of the rails which was not present in the days of steam operation One form of this wear is known as "battering," which results in hollows that develop at distances of from two to three feet apart. It is generally found on the inner rail on curves. Corrugation is a well-known phenomenon on electric roads and constitutes one of the most puzzling features of rail wear under electric traction This trouble is no doubt largely due to the fact that part of the weight of the motors is carried directly on the axles without the intervention of springs and that the center of gravity of the motor car is much lower than that of the steam locomotive. A partial remedy has been found in the use of high silicon rails, which show an increased life of about 30 per cent over rails of the standard composition.

ELECTRICITY.

An electrolytic process for the production of bleaching solution is used by the Amazon Knitting Mills of Muskegon, Mich., by which the cost of bleaching is said to be less and the results obtained much more uniform

Japan is falling in with the general movement for the electrification of railways and the Hachioji Kafu line of the Japanese middle district railway is to be electrified Fifteen motor cars have already been ordered from the Osaka Railway Carriage Company

The Canadian Department of the Interior has recently been estimating the available water power of Dominion streams, and concludes that there is over twenty six million horse-power in accessible localities, of which only half a million has been hitherto developed The largest power is on the Hamilton River in Labrador where 9 000,000 horse-power is available, the Canadian part of Niagara Falls coming second.

The Electrical World has an interesting discussion of Prof Marks s article on the price of electric service It is pointed out that on account of the difficulty of cheaply storing electrical energy the consumption of any individual user is as important a factor in the cost of serving him as the operating cost, and that it is therefore reasonable for some sort of standing charge based on his estimated or measured demand to be made in addition to a service charge based on operating cost.

Machinery aggregating 10 000 horse-power and other equipment to the total value of $400 000 is now on its way to Dawson City where Klondike mining operations are expected to be facilitated by the provision of electric power An English company has taken over the present power station the only coal mine in the district and the local telephone system Water power is available for part of the year but is complicated by floods at one season and drought at another The present power plant uses wood fuel largely the local supply of which is becoming exhausted and considerable economies are expected from use of coal screenings hitherto wasted at the new company s power house which will be erected at their mine

The city of Glasgow Scotland whose record for an efficient and economical municipal tramway system is well known has also a remarkably well-conducted electric light and power supply department according to figures recently received for the past year s working In spite of a decrease in income of $38 000 due to reduced charges for current increasing use of economical metallic filament lamp and general trade depression an actual increase in available profit balance of $14 000 has been made The aggregate horse-power sold is 29 500 an increase of 6 000 over the previous year and 1 232 new consumers have been added Eighteen million units out of thirty three sold were for power purposes bringing in on the average 1½ cents per unit

The experiments, which we described about a year ago with apparatus for the destruction of harmful moths by means of a combination of electric light and a suction blower have been repeated with great success at Zittau in Germany The beam from a search light mounted on the roof of the municipal electric plant is played upon the forest several miles distant and the moths come fluttering up the beam in swarms to where the intake of a powerful suction blower is concealed below massed arc lamps. The moths are drawn in by the suction and exhausted into a wire net cage which is removed as often as filled As much as 140 pounds weight representing some 400 000 moths has been destroyed in this way in one night

It is not generally known that the disturbances in Persia reports of which from London have occupied much space in the press of late, pass over the longest telegraph circuit in the world The telegraph operator at Teheran "speaks' directly to his colleague in London, 4 000 miles away, by wire, automatic repeaters taking the place of operators at ten points on the route The first repeating station from London is at Lowestoft, where the message is carried forward 200 miles by cable under the North Sea to Emden Hanover, where it is again automatically repeated, stations at Berlin Warsaw, Rouno Odessa Kertch Sukhum Kaleh, Tiflis, and Tauris flash it instantaneously without human intervention, the operator at Teheran being the first to handle it since it left London The line is continued to India, but in no other place is there so long an automatic circuit.

Mr. George H. Cove of Somerville Mass has a solar thermo-battery which is claimed to produce enough current in ten hours' sunlight to supply thirty tungsten lamps for three days. The apparatus consists of a frame of violet glass, like a large window, below which a number of metallic plugs are set in an insulating material. One end of each plug is constantly exposed to the sun while the other is shaded and cool, and the rays permitted to pass by the violet glass set up a reaction in the special alloy used, causing a constant flow of current to the storage batteries.

SCIENCE.

The famous lion of Lucerne appears to be doomed. The entire face of the sandstone rock in which the figure is carved is falling to pieces, and in spite of every effort on the part of the local authorities, the lion is crumbling away and becoming disfigured

The Duke of the Abruzzi has made a new record in mountain climbing The highest ascent hitherto made in the Himalayas the scene of the Duke s exploit, was by the Norwegians Muradas and Robertson, who reached a height of 7,300 meters (more than 23,725 feet) The Duke mounted Bright s Peak which is 7 600 meters (above 24 700 feet) in height This peak is in the Godwin Austen group

Scientists now have placed at their disposal the highest meteorological and astronomical observatory on the American continent It is situated on the top of Mount Whitney California 14 000 feet above sea level Realizing the value for effective and progressive astronomical and meteorological work of an observatory far above the clouds and free from dust and smoke near great cities, the Smithsonian Institution decided to build a suitable laboratory on Mount Whitney Now that the observatory is opened it will be used by scientists of the Smithsonian Institution and by others to make observations. The Smithsonian will permit the building to be used by any scientist gratuitously

We have already made the statement in these columns that the Lick Observatory under W W Campbell sent an expedition to the top of Mount Whitney for the purpose of spectroscopically comparing the atmospheres of the moon and Mars the object being to settle once and for all the mooted question of Martian water Inasmuch as the moon has an atmosphere which if not non-existent is at least inappreciable the comparison of its spectrum with that of Mars s atmosphere should prove conclusively whether or not there is any water on Mars A telegram has been received at Harvard College Observatory from Prof Campbell in which he states that together with Dr Albrecht he compared the spectra of Mars and the moon and detected only a little water vapor on Mars The bands which were measured were of equal intensity and very faint A reply from Prof Lowell will naturally be looked for with some interest It will be remembered that Mr Slipher of Prof Lowell s staff has stated that he discovered spectroscopic evidence of water on Mars.

The common impression that the soils of the United States are wearing out and that the crop yields are on the decrease is declared to be erroneous by Prof Milton Whitney chief of the Bureau of Soils The results of his investigation will be published in the next bulletin of the Department of Agriculture In summing up Prof Whitney says that a careful study of the data appears to justify two conclusions—first that the productivity of the newer agricultural soils of the United States is not decreasing Individual farming deteriorates and soils wear out but as a whole it seems probable that we are now producing more crops per acre than formerly The cultivation of the land has been more intelligent the principle of rotation of crops has been better observed and in latter years, a more careful use of fertilizers has been made In addition we must recognize the increase in farm animals and stock the improvements in such by selection and breeding and the increased population which is forcing attention to more intensive methods of cultivation

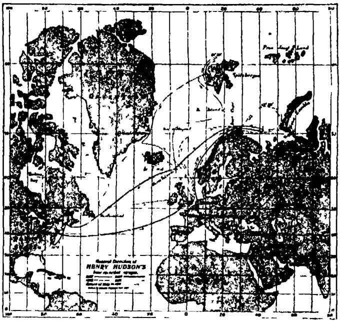
An effective method of freeing the air of rooms from dust and germs is especially desirable for primary schools children s hospitals surgical operating rooms and spinnin mills The method hitherto in use consists in supplying a current of air which has previously been purified more or less completely Richet has devised a simple method of purifying the air confined in a room by causing it to circulate continuously through an apparatus which retains the dust and microbes. The apparatus is simply an electric fan which revolves in a vertical cylinder and produces a current of nearly 2 cubic feet per second Water or some other liquid drips from a 3-quart vessel at the rate of 1 quart per hour, upon the blades of the fan from which it is projected by centrifugal force in fine drops to the wall of the cylinder The impurities of the upward blast of air are caught by the spray which then trickles down the cylinder to a large basin in which the whole apparatus is set. Richet employed glycerin and soap solution but the air can be purified very well by a spray of water alone. One hundred thousand microbes estimated by the usual methods were thus collected in three hours from the air of the laboratory The dried organic matter collected in the same interval weighed about 1 grain, and the mineral matter ¼ grain The same apparatus can evidently be employed for the chemical purification of the air by substituting appropriate solutions—cuprous chloride for the removal of carbon monoxide, potash or soda for carbon dioxide, etc.

HUDSON AND HIS EXPLORATION OF THE HUDSON RIVER.

The name of Hudson has been given to the Hudson River not by any means because he was its original discoverer but because he was the first navigator to explore the river throughout its navigable length and leave behind a detailed account of his voyage. It will therefore be fitting to preface the present record of Hudson's voyage by a brief reference to the discoveries of earlier explorers.

After the return to Spain of the remnant of Magellan's expedition in 1522 it began to be well understood in Europe that a vast ocean must separate the New World and Asia, and the early navigators forthwith began to search for some route by which they could avoid the long journey from Europe to Asia by way of the southern seas and find a direct route in more northerly latitudes. The explorers sought eagerly for a northwest passage gradually laying their courses farther and farther up among the ice floes of the Arctic regions. The eastern coast of North America was carefully searched and the tiny caravels of those days were sailed into the mouths of great rivers in the hope that they would prove to be straits or channels opening through into the Western Ocean. Among these early explorers was Lucas Vasquez d'Allyon who tried for a passage by the James River and through Chesapeake Bay in 1524. In 1525 Estevan Gomez sailed down the coast from Labrador to Florida making a record of Cape Cod, Narragansett Bay and successively of the mouths of the Connecticut, the Hudson and the Delaware rivers. Early in 1524 Giovanni da Verazano who was born in 1480 at Florence crossed the Atlantic with a single ship and a crew of fifty men. He sighted Cape Fear N. C. and coasted north to latitude 50 deg. About the last of April 1524 the Dauphine as Verazano's craft was called arrived off a low point of land now known as Sandy Hook where seeing an inviting harbor Verazano sailed into the roadstead. The ship's boat was manned and rowed through the Narrows into the Upper Bay where a hasty survey was made of its islands and inlets and the mouth of the noble river which flowed into it. He speaks of the river as a very great river (*una grandissima riviera*), and the name Grande River was used by some of the leading map makers of Europe during the sixteenth century. When the Dutch took possession of this part of the country the name Groote was substituted for the Italian term. Henry Hudson was no doubt induced to explore the Grande River by a letter from Capt. John Smith who wrote that it was a strait connecting with the western sea which in those days was believed to lie not very far from the Atlantic seaboard.

Of Henry Hudson the man we know comparatively little and that little is comprised within the years 1607 and 1611. He was born in or near London but of the exact date of his birth there is no certainty. His first appearance is on April 19th 1607 when with eleven companions he is found partaking of Holy Communion in a little church in London prior to embarking on his first recorded voyage. Our last sight of him is when he passes from view among the mists of Hudson Bay on June 22nd 1611 turned adrift with a few companions by the mutinous crew of the Half Moon. No authentic portrait of the man exists. He came of a seafaring family had a wife and children and evidently belonged to a prominent family. He made four recorded voyages the first second and fourth under English auspices and the third under the Dutch. In 1566 Parliament incorporated "The Fellowship of English Merchants for the Discovery of New Trades" which was better known as the Moscovy Company and it was in their employ that Hudson on his first voyage made an effort to reach China by passing between Greenland and Spitzbergen. At latitude 81 deg. 30 min he was checked by the Arctic ice and returned home. This voyage lasted from April 23rd to September 15th 1607. The second voyage in 1608 lasting from April 22nd to August 26th had the same object in view. This time he endeavored to pass between Spitzbergen and Nova Zembla. After reaching latitude 75 deg. 30 min he was driven back by the ice. In 1609 he entered the service of the Dutch East India Company, and made the voyage which resulted in the exploration of the Hudson River. His last voyage made under the auspices of the Moscovy Company commenced on April 17th, 1610, had for its object a search for a northwestern route to the Pacific Ocean through what is now called Hudson's Strait and it was here in the following June that Henry Hudson, John Hudson, and seven others mostly sick and disabled were set adrift by the mutinous crew in an open boat, with a gun, some powder and shot, an iron pot, some meal and a chest of carpenter's tools. The ultimate fate of the great explorer whether he died of starvation or drowning or was frozen to death is a matter of pure conjecture.



The voyage of 1609 during which he discovered the Hudson River is shown by a full black line

MAP SHOWING HENRY HUDSON'S FOUR RECORDED VOYAGES, 1607-1610.

On the 8th of January 1609 a contract was made between "the Directors of the Dutch India Company of the Chamber of Amsterdam" and Mr. Henry Hudson Englishman assisted by Jodocus Houdius who was to act as interpreter. In the Dutch copy of the contract preserved at The Hague Hudson's Christian name is three times spelled Henry and he signed the document in the same way so that in the opinion of the Hudson Fulton Celebration Commission, as he was an Englishman, it is a mistake to call him Hendrik.

The Half Moon set sail from Amsterdam April 4th 1609 with a crew of eighteen Dutch and English sailors. The object of the voyage as per the contract was to seek a passage to the north of Nova Zembla and by an easterly course to reach what is now the Pacific, in the latitude of 60 deg. On May 5th he rounded North Cape, but, baffled by the ice and by the discouragement of his crew, he determined, instead of returning home, to sail direct to the coast of America at the latitude of 40 deg., where he hoped to find a northwest passage by a strait which his friend, Capt. John Smith, in the letter sent to him from Virginia, informed him led into the Western Ocean somewhere between New England and Virginia. On July 18th he cast anchor in a harbor on the coast of Maine. He touched at Cape Cod, sailed to a point one hundred miles south of Chesapeake Bay, and then turned northward again and entered Delaware Bay. Finding the river unnavigable, he ran back to the ocean and sailed up the coast, and on September 2nd was off the New Jersey shore and anchored probably off what are known as the Navesink Highlands to the south of New York Bay. On the following day the "Half Moon" let go her anchor inside of Sandy Hook. The week was spent in exploring the bay with a shallop, or small boat, and "they found a good entrance between two headlands" (the Narrows) "and thus entered on the 12th of September into as fine a river as can be found."

The log of this voyage was kept by Robert Juet who was probably the mate of the "Half Moon." It is written in the quaint English of that period, and is entitled "The Third Voyage of Master Henry Hudson, toward Nova Zembla, and at his return, passing from Farre Islands to New-Found Land, and along to Fourtie-Foure Degrees and Ten Minutes, and thence to Cape Cod, and so to Thirty Three Degrees and along the coast northward to Fortie-Two Degrees and one Halfe, and up the river neere to Fortie-Three Degrees."

In his passage up the river, Hudson made progress according as wind and tide were favorable, the time from sundown to sunrise being always spent at anchor. On Monday the 14th he passed through a "very high and mountainous" country probably the Highlands. On the following day, mention is evidently made of the Catskills, when the log records that they "came to other mountains which lie from the river side." On Saturday, the 19th, the little ship had reached the northerly limits of its trip and anchored off what is probably now the northern section of the city of Albany. Further exploration of the river was made in the shallop, in the expectation of finding deeper water beyond the shoals. This was a vain hope however, and the conviction must finally have come to the heart of the intrepid adventurer that once again he was foiled in his repeated quest for the northwest passage. On Wednesday the 23rd, the "Half Moon" started on her return trip down the river. On the 29th she was at the northern entrance to the Highlands having reached "the edge of the mountaines or the northermost of the mountaines." Detained by a heavy gale until October 1st, Hudson weighed anchor on that day and reached Stony Point. Finally, on Friday, the 2nd, the "Half Moon" cast anchor off "a cliffe that looked of the colour of a white greene," which is considered to have been undoubtedly "the green serpentine outcrop" at Castle Point, Hoboken.

Evidently the "Great River" made the same pleasing impression upon Hudson as it has done on the many millions who have voyaged between its banks in the intervening three centuries. Says he "It is as pleasant a land as one need tread upon. The land is the finest for cultivation that I ever in my life set foot upon." With a few exceptions, he found the native Indians to be friendly disposed. Dressed in skins and with the characteristic decoration of feathers, wearing copper ornaments on their necks and carrying bows and arrows, they smoked large red or yellow copper tobacco pipes. To the little ship they brought tobacco, dried currants, grapes, corn, pumpkins, and beaver and otter skins, which they bartered for knives, hatchets, and trinkets. The country appears to have been quite populous with the Indians, who lived in dome-shaped huts, built of saplings and covered with bark. They existed chiefly on corn, which, together with beans, was dried for their winter use. Fish and birds also formed part of their diet, and mention is made of salmon, mullets, rays, and sturgeon. At the various places where Hudson landed he was usually received [illegible] and with no little ceremony. It is evident that Hudson's treatment of the Indians was kindly, and the [illegible] [illegible] the [illegible]

The raised superstructure forward contains the quarters for the crew. Below the bowsprit, furled on its yard, is the curious square sail known as the "blind sail." The sailors are dressed in the costume of 1609

THE REPLICA OF THE "HALF MOON", PHOTOGRAPH TAKEN JUST BEFORE SHE WAS SHIPPED TO AMERICA.

to have a beneficial and lasting effect on the subsequent history of this State.

It was while at Albany that Henry Hudson decided "to trie some of the chiefe men of the countrey whether they had any treacherie in them", and accordingly he "tooke them down into the cabin and gave them so much wine and aqua vitae that they were all merrie, and one of them had a wife which sate so modestly, as any one of our countrey women would do in a strange place In the end one of them was drunke'

Not always was the intercourse of this convivial character After the return of the "Half Moon" to the lower harbor, and when John Coleman and four others were exploring in the shallop, they were attacked by the natives, and Coleman was killed This was on September 6th. Other conflicts occurred on the 9th and the 15th of September, and on October 1st, the log records how an Indian who had climbed up the rudder to the cabin window was caught stealing and shot. The following day the Indians attacked in force, and were driven off with a loss of eight or ten killed On the 4th of October the 'Half Moon" sailed down the harbor and out to sea, and "on the seventh day of November," according to the log 'being Saturday by the grace of God the Half Moon' safely arrived in the range of Dartmouth in Devonshire in the year 1609"

THE "HALF MOON"

When the replica of Henry Hudson's "Half Moon' was lifted by the floating crane at the Brooklyn navy yard from the deck of the "Soestdyk,' on which she was brought over from Holland, and lowered into the water, there was a general expression of surprise at her diminutive appearance for she was actually no larger than a small harbor tug On rowing over to the craft and going aboard, however, it was at once evident that what she lacked in size, she more than made up in general staunchness and strength of construction Bluff of bow and high in the poop, as was the fashion in naval architecture of three hundred years ago, built of heavy oak timbers, and planked and decked with the same material, the Half Moon was well calculated to stand the buffetings of long deep-sea voyages. Moreover her underwater model is such with its long clean run, that, although it must have been slow work beating to windward it is certain that with the wind free and sheets started the little craft must have been good for say six knots, and possibly—under favorable circumstances—a little more than that. All the same in view of the diminutive size and exceedingly cramped quarters of the Half Moon," one is filled with admiration for the daring and resourcefulness of the men who struck boldly to the northwestward in such a cockle shell of a boat, on voyages of many months duration and in a quest for a northwest passage which must needs lead them on to dangerous coasts and amid treacherous shoals, of which there was no chart, beacon or buoy to give them friendly guidance

The 'Half Moon must be seen to be appreciated Of 80 tons displacement, she is only 80 feet in length over all, 63 feet on the waterline 16 feet 11 inches beam, 10 feet 1 inch molded depth and 7½ feet draft of water She was built by a committee of patriotic Dutch citizens, who provided the necessary funds, her plans being drawn from original sketches and documents prepared by the late instructor of shipbuilding in the Dutch navy In the parade up the Hudson River she will be manned by officers and a crew from the Dutch ship of war 'Utrecht," all dressed in the quaint costumes of three hundred years ago Forward is the raised forecastle, the sleeping place of the crew, provided with five berths. Forward of this and below the bowsprit is the galley, an extraordinarily exposed and wet position, where, says tradition, the sailors were placed for punishment. At the after end of the boat on the main deck was the position for the steersman, whose head projected through the steeply-sloping quarter deck above him and was protected by a curious canopy In front of the steersman were a compass, a sand glass, and a log glass. Upon the main deck and covered in by the steeply-sloping deck, known as the quarter deck, is the captain's cabin. Under his berth, in an artistically bound chest, are the books which comprised the captain's small library Upon the diminutive table is a sea chart, a faithful reproduction of the one existing copy, mentioned by Shakespeare, which is in the British Museum On the table also is a copy of the contract with Hudson for his notable voyage, dated January 8th, 1609 Here also are the primitive dividers and measuring scales for plotting the course The cabin contains a Jacob's staff the primitive sextant with which Hudson determined with a fair amount of accuracy, his latitude All of these articles are faithfully copied from prototypes in the Netherland Museum. Above the captain's cabin is a smaller one for the accommodation of the mate, and above this is the lofty poop deck

From a naval constructor's point of view, one of the most curious things about the 'Half Moon" is the exaggerated upward slope of the after part of the main deck and of the quarter and poop decks above it, the effect of which was to give great elevation to the poop Curious indeed to our eyes is this lofty structure but it must have been an excellent position from which to navigate the ship About four feet below the main deck is the tween deck or the orlop deck where the head room is so limited that the crew must have at times performed some of their duties on all fours Here are the two old fashioned cannon the primitive kitchen and berth for the cook a bread room and berth for the steward and a gunner's room in which the powder was stored Below is the hold in which were stored the provisions, drinking water cable and cargo The Half Moon carries three masts and a bowsprit Below the latter is a curious square sail known as the 'blind sail On the foremast are a foresail and a topsail on the mainmast a mainsail and a main topsail and on the mizzen is a lateen sail The shrouds stays, spars and in fact the whole of the rigging, standing and running is exceedingly strong and well set up The old Dutch East India Company, whose chief office was in Amsterdam, placed on all its vessels the initial letter of the port from which they sailed This accounts for the large letter A on the stern of the 'Half Moon" Other signs painted on the vessel are a starry heaven a comet, planets, and a half moon Below these are the name of the vessel and the arms of Amsterdam and of the company

Note the steel cradle in which the boat was carried on the deck of the Soestdyk." The transfer was made by the floating crane

"HALF MOON" BEING LIFTED FROM STEAMSHIP TO DOCK AT THE BROOKLYN NAVY YARD

View looking aft, showing the lofty poop containing the steersman's position and the cabins for Hudson and his mate

DECK VIEW OF THE "HALF MOON."

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THE FOUR PERIODS OF HUDSON RIVER HISTORY

For the lovers of history none of the pageants of the Hudson Fulton Celebration will equal in interest the great parade of Tuesday September 28th which will tell the story of the past three hundred years of Hudson River history in a procession of over half a hundred floats representing the successive periods of Indian Dutch English and American occupation

Henry Hudson during his exploration found the river occupied by two great branches of the aboriginal Indians the Algonquins at the mouth and in the lower river and the powerful league of the Iroquois, or Five Nations, at its head With a few slight exceptions Hudson's reception was friendly and both he and his crew appear to have treated the Indians with consideration It is certain that such conflicts as occurred were insignificant in comparison with the battle fought between the Canadian Indians under Champlain on the shores of Lake Champlain and a party of Iroquois Indians—a conflict which occurred only a few days before Hudson sailed into New York Harbor The contrast between the French and the Dutch and English treatment says the Hudson Fulton Commission led to the formation of the famous Covenant Chain of friendship between the Indians and the latter and prevented the French from ever obtaining a permanent foothold in the State of New York

The Dutch who succeeded the Indians as owners of what is now New York State, were in 1609 the leading commercial nation of the world and Amsterdam from which Hudson set sail was its leading port The interest aroused among the early Dutch traders by Hudson's voyage led to the erection as early as 1613 of traders huts along the Hudson River The first permanent settlements were made at Fort Orange (Albany) in 1624 and at New Amsterdam (New York) two years later The colonial history of New Netherland began with the landing on Manhattan Island of Peter Minuit as the first Governor-General in 1626 Under New Netherland was included the territory between the Connecticut and Delaware rivers The English took possession in 1664 surrendered to the Dutch in 1673 but once more gained possession this time destined to be permanent in 1674

Henceforth New Netherland was to be known as New York, New Amsterdam as New York city and New Orange as Albany but the Dutch origin of New York is still commemorated in such names as Brooklyn Harlem and Staten Island Regarding this momentous change, the Commission is of the opinion that the merger of the Dutch and English *régimes* was accomplished more completely and naturally than a change of jurisdiction could have been made between almost any other two nations in the world for the Dutch were more closely allied to the old Anglo-Saxon stock from which the English are descended than any other living European people Intense rivals in commerce England and Holland had worked hand in hand for years for the liberties of Europe and there were radical bonds of sympathy between them which contributed materially to the progress of the colony of New York

The American or United States period began of course with the Declaration of Independence on July 4th 1776 The geographical position of the Hudson River, which forms part of the great highway of travel from the Atlantic seaboard to the Great Lakes and Canadian territory rendered it strategically of the very highest importance and, therefore the main object of contention between the opposing forces The British realized that if they could establish complete possession of the Hudson Valley they would cut the colonies in two and by establishing a route of communication between Canada and New York they would be able to defeat the colonies in detail The vast range of incidents connected with the Hudson River Valley has rendered it necessary for the Commission to confine the floats to the representation of events more immediately connected with New York city

FULTON AND HIS LIFE WORK.

The forthcoming festivities commemorate the first complete exploration of the Hudson River by Henry Hudson and the inauguration by Robert Fulton of successful commercial steamboat navigation on its waters. Hudson was not the first navigator to see the Hudson River, and neither Robert Fulton himself nor the Commission which has organized and carried through the celebration has ever claimed that Fulton was the original inventor of the steamboat It is rarely that a complete invention leaps full fledged from the brain of any one man Almost invariably it is the product of the disconnected labors of separate individuals each of whom contributes his quota to the ultimate result Three men above all others—Symington on the Forth and Clyde Canal Fitch on the Delaware and Fulton on the Hudson River—will be for ever associated with the invention of the steamboat and it is because Robert Fulton combined with his fine engineering sense a large executive and commercial instinct, and was backed by the financial and political influence of Chancellor Livingston that he was able not only to put a practical steam ship afloat on the Hudson River but to establish the infant enterprise as a permanent commercial success

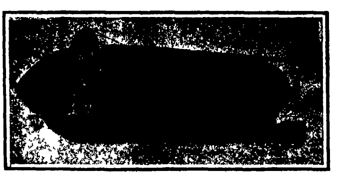
Fulton was born in Little Britain Lancaster County Pennsylvania in 1765 As a boy he showed a decided gift for drawing and mechanics to which was joined an unusual facility for mathematical calculations. At seventeen years of age he went to Philadelphia to take up the study of portrait and landscape painting and mechanical drawing In this he must have shown considerable ability, for at the age of twenty-one he had saved sufficient means to purchase a home for his widowed mother in Washington County In the following year he went to England to study art under his distinguished compatriot Sir Benjamin West who subsequently in 1792 was elected president of the Royal Academy That Fulton was an artist of no small attainment is shown by the character of the work which has survived him and by the fact that his portraits were exhibited at the Royal Academy and at the Society of Arts in Great Britain His own portrait, painted by his brush which now hangs in the rooms of the American Society of Mechanical Engineers in New York is an excellent piece of work and shows distinctly the influence of the master under whom he studied

From a painting by Benjamin West in possession of Fulton's grandson, Robert Fulton Ludlow, of Claverack, N Y.

ROBERT FULTON; 1765-1815.

An artist by profession Fulton was an engineer and inventor at heart Benjamin West's influence coupled with his own charm of personality and undoubted social gifts brought him into touch with many leading men in England notably the Earl of Stanhope, whose interest in mechanical and physical science is well known On September 30th, 1793, Fulton wrote to the Earl offering to make known to him his scheme for moving ships by steam and his plan for an inclined plane for the operation of canals In the same year also he invented a mill for sawing marble and other stone and actually had one in operation near Torbay Devonshire His interest in steam navigation at this time is shown by a letter to Boulton & Watt dated November 4th 1794, asking what would be the cost of a steam engine, "which is designed to be placed in a boat The letter was written from Manchester where he met young Robert Owen subsequently known as the distinguished social reformer Fulton interested Owen in his plans for the more rapid and cheaper excavation of canals, and they became copartners in his inventions Meanwhile he was writing a 'Treatise on Canal Navigation' which appeared in 1796 In 1797 he went to Paris where he obtained two French patents for panoramas A lasting evidence of his work in this direction is to be found in the Rue des Panoramas and the Passage des Panoramas in the French capital Here he lived with the American Minister Joel Barlow of whom he painted an excellent portrait now owned by his descendant Robert Fulton Ludlow of Claverack N Y It was during his residence in Paris that he began to turn his genius for invention almost exclusively to the field with which his name was to be so honorably associated His first efforts were directed to the invention of means for prosecuting submarine warfare He invented a system of torpedoes operated by clockwork, and devised methods of attack which were wonderfully similar to those that were used with such disastrous effect in the late Russo-Japanese war He proposed to float down upon the enemy two such torpedoes tied together by a line, which, being intercepted by an enemy's ship would swing around, strike her sides, and explode His most effective work in this field was the construction of a practical submarine or "plunging" boat, called the "Nautilus" This vessel, 6 feet in diameter and 20 feet long, was built of iron and copper and in general outline resembled the modern submarine It was provided with a sail for surface navigation, which could be folded back upon the boat when diving. To submerge the boat, water was admitted, which was removed by pumping when it was desired to come to the surface. It was driven by means of a propeller through a man-operated crank wheel, from which power was transmitted through bevel wheels to a propeller shaft running through the center of the boat. The steering, operation of the pump, and the raising and lowering of the sail, were all accomplished from the interior by the methods shown in the accompanying engraving. Fulton made an exhibition on the Seine, descending with one man, remaining twenty minutes below the water, and coming successfully to the surface. At Brest, in June, 1801, he descended with three men to a depth of twenty five feet, and remained below for one hour, the air being renewed from a reservoir of air under high pressure. On another occasion he attacked a specified boat in the harbor, attached one of his torpedoes, and blew the boat to pieces. This occurred in August, 1801 The significance of these exploits is enhanced when we bear in mind that the experiments above referred to were made to demonstrate to Napoleon I the value of Fulton's invention for attack upon the English fleet. His plan was to build steamboats which were to act as tugs to tow the vessels containing Napoleon's army of invasion across the English Channel, and while the steamboats were to afford Napoleon an opportunity to strike a blow upon land with his army, Fulton's system of submarines would enable the French navy to strike an equally telling blow by sea As the French government failed to accept Fulton's submarine and torpedo inventions, he subsequently returned to England and laid his plans before the British government Mr Pitt, the Prime Minister, was favorably impressed, and Fulton was given an opportunity to attack a brig which was anchored off Deal in the English Channel He launched a torpedo, and by completely destroying the vessel demonstrated to naval and military officers and to a large concourse of spectators the success of his invention. The British government however, for obvious reasons, did not wish to encourage the development of submarine warfare, for they realized its great potentiality They offered Fulton a considerable reward if he would suppress his plans forever This he refused to do, saying to the committee that waited upon him "I will never consent to let these inventions lie dormant, should my country at any time need them."

THE BRONZE MEDALLION OF ROBERT FULTON ON HIS MONUMENT IN TRINITY CHURCHYARD.



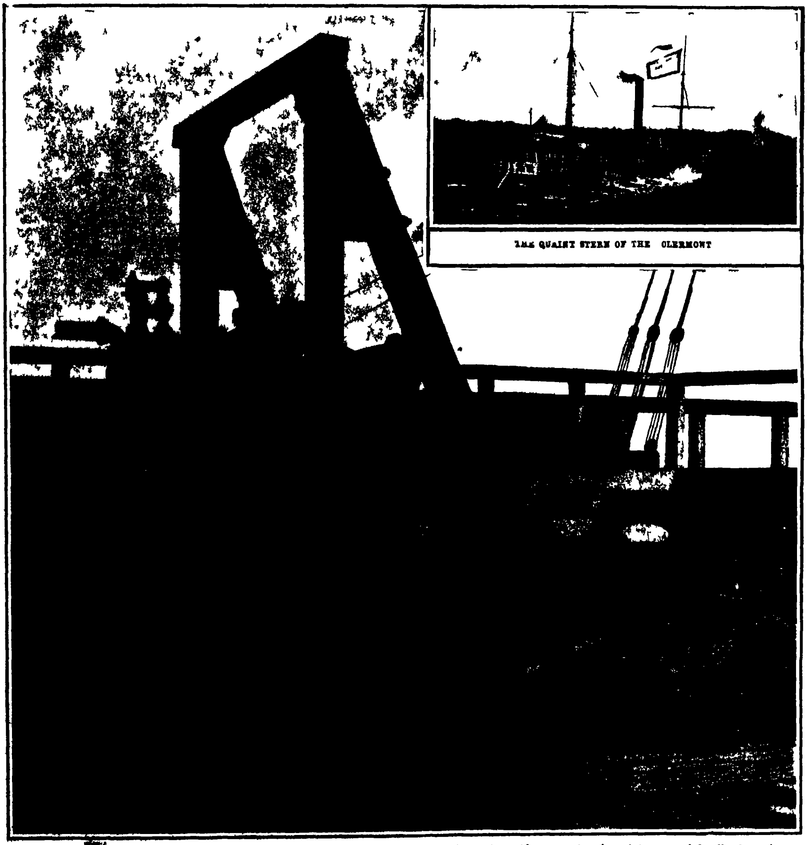
Built of copper and iron; driven by a hand crank and propeller; was submerged by admitting water, air was replenished from a tank of compressed air, remained under water 5 hours with three men aboard.
Fulton is the undisputed inventor of the first successful submarine He antedated the present submarine boat by 100 years and demonstrated by successful tests before officials, first of the French and later of the English navy, the practical character of his vessel.

FULTON'S SUBMARINE THE "NAUTILUS."

Fulton, again a resident in France realizing that he had failed to interest either government in his system of submarine warfare, turned to his favorite scheme, and bent his energies to the development of a practical steamboat. He made application to the French government, filing a description and plans of his boat, which have been preserved in the archives of the Conservatoire des Arts et Métiers, Paris. The wide study of what had been done and was then being attempted in the development of the steamboat with which Fulton prepared himself, is shown in these plans, and the reader is directed to the illustration of the boat in the chapter on 'Steamboats Prior to the Clermont," which appears on page 221. The drawing is especially valuable for the light which it throws upon the "Clermont," of which the original drawings have disappeared The date of the letter to the French Commission was January 26th, 1803 Fulton built a small boat, in which he placed his boiler and engine, but on the eve of his demonstration before the Commission, during a heavy wind, the craft, unable to carry its burden, broke in two, and the wreck sank to the bottom of the river The engine, which was presumably the one ordered from Watt, seems to have come through the disaster unharmed, for Fulton immediately built another boat, 66 feet long by 8 feet beam, and in August, 1803, made a fairly successful trial in the presence of members of the Institute and a crowd of onlookers. In spite of this demonstration, Fulton was doomed to disappointment, for the French government failed to take up his invention But his star was now in the ascendant. The wheel of fortune took a turn in his direction, when Robert R Livingston was sent to France to act for the United States in the matter of the Louisiana Purchase. This able man, who had himself already given much study to, and made several experiments in, the development of the steamboat, was quick to see the excellence of the Fulton plans, and became from that time on his ardent associate and never-failing backer "Fulton had genius, and Livingston had the genius to perceive it", and out of the combination of interests thus formed, there was to emerge four years later that curious but capable little craft, the "Clermont"—practically identical in design, and the lineal descendant of, the boat which steamed successfully on the

THE CLERMONT'S TRIAL TRIP: SEPTEMBER 14TH, 1909.

DECK VIEW SHOWING FLYWHEELS OUTSIDE HULL



THE QUAINT STERN OF THE CLERMONT

With the exception of the eccentric valve gear, and starting and stopping mechanism which were modernized in accordance with government requirements to insure safe handling during the parades, this replica is an exact copy of the original of 1807.

The main parts of the engine were built by Watt in England in accordance with Fulton's order of August [illegible], 1803, which called for a cylinder of [illegible] a 4-foot stroke, the valves and movements for opening and shutting them, the air-pump piston and rod, the condenser with its [illegible] and air pump. The A frame and guides, the cross-head, the bell-crank lever with its connecting rods to cross head and crank, the crank [illegible] paddle wheels and shaft, and the flywheels and shaft with gear for driving the same were all Fulton's own design, and the arrangement was well adapted for keeping the weight low in his very narrow boat with its small margin of stability. In the original engine the valves were probably operated by a vertical reciprocating rod carrying pins which engaged the valve tripping devices.

(Drawn on board the replica of the "Clermont" by the artist of the SCIENTIFIC AMERICAN.)

THE ENGINE OF THE "CLERMONT"

river Seine Preliminary to our description of the Clermont it is well to make it clear that Robert Fulton is entirely free from any charge of plagiarism It has been asserted that because Fulton inspected the work both of Symington on the Clyde and Fitch on the Delaware and was familiar with Fitch's plans as left in charge of Aaron Vail U S consul at L'Orient, France, it was from these sources that he derived the design of the Clermont ' Now, while it is true that Fulton was in touch with these men and their work and probably saw their steamboats in operation there is nothing in the design of the 'Clermont" to indicate that her hull and the general arrangement of her engine were not the design of Fulton himself On the contrary there is abundant written evidence that the form of the boat and the connections from the cylinder to the paddle wheels were Fulton's. This is said with due appreciation of the fact that Fulton went to Boulton & Watt at Birmingham England for the essential parts of his engine They were the foremost engine builders of their day and it was a wise step on Fulton s part to order the cylinder, condenser and air-pump from a first class firm Both Fitch and Symington it is true, designed and built their own engines throughout but this fact does not invalidate Fulton s claim to be considered as the naval architect of the 'Clermont —a boat which was quite unlike any other that had been built and that was so well designed as to prove a thorough commercial success.

While Fulton was yet in Paris and a few days before the trial of his boat on the Seine, he again wrote to Boulton & Watt asking them to build him an engine, which he no doubt intended for the boat that he had in mind to build on his forthcoming return to America On the date of August 6th, 1803 his letter says Will you be so good as to make me a cylinder of a 24 horse-power double effect, piston making a 4 foot stroke? Also the piston and piston rod the Valves and movements for opening and shutting them, the air pump piston and rod, the condenser with its communications to the cylinder and air pump The bottom of the cylinder cast in form as in the drawing and the dispositions of the parts as near as possible as they stand in the drawing The other parts can be made at New York The situation for which this engine is designed and the machinery to be combined with it, will not admit of placing the Condenser under the cylinder as usual' The drawing which accompanied this letter showed the condenser placed forward of the cylinder and not underneath it, as was the practice in the Boulton & Watt engines. Mr H H Suplee who has probably given a more thorough study to this phase of the subject than any other investigator is of the opinion that Fulton wished to place his cylinder directly upon the floor of the boat in order to keep its weight as low as possible.

Designed by Fulton for the United States Navy launched in 1814 and completed shortly after his death Length 150 feet beam, 56 feet depth 20 feet, paddle wheel 16 feet diameter, engine cylinder, 4 feet diameter, 4 feet stroke, speed, 4½ knots.

THE "DEMOLOGOS"; THE FIRST STEAM WARSHIP.

This view shows the engine B driving paddle wheel C in a central waterway, the boiler A and the massive wooden side protection E, 5 feet in thickness

MIDSHIP SECTION OF THE "DEMOLOGOS."

The armament consisted of twenty 32-pounder guns. The plans provided also for two 100-pound submarine guns for attacking the enemy below the water-line.

GUN DECK OF THE "DEMOLOGOS."

We are inclined to agree with him for the original beam of the Clermont which was only 13 feet rendered her laterally very unstable Furthermore the boat on the Seine which doubtless formed the basis of the design of the Clermont" shows the condenser separate from the cylinder There can be no doubt, after reading the Boulton & Watt letter, that Fulton had the outlines of the Clermont" engine clearly in his mind and its general similarity to the engine of the boat on the Seine is strong evidence that the "Clermont's engines were at least as to their general plan and connections original with Fulton On the other hand the drawings which accompanied Fulton's patent of 1809 show the condenser placed beneath the cylinder a construction which has been followed in the replica of the engine

In drawing the plans it was found that, since the replica of the 'Clermont would have a considerable number of people aboard during the festivities parades, etc., it would be necessary to depart somewhat from the original plans, in order to comply with the requirements of the government inspectors and secure a reliable boat, suitable for the purposes of the Commission Hence, in the interests of historical accuracy, it is advisable to note that the motive power departs in some respects from Fulton's original design, although in the main it is a faithful reproduction. This is particularly true of the eccentric, valve gear, cut-off and starting and stopping devices, and it takes only a glance at our drawing to see that these parts belong to a later period, and are practically similar to those now in use on walking beam engines In the drawings of the boat on the Seine the valve gear and the air pump are shown to have been operated by levers and quadrants Probably Fulton used the "tappets and tappet rod," which were current practice for working the valves in Boulton & Watt engines Another change is in the boiler, which in the original "Clermont" was built of copper and carried a pressure of probably not more than three to five pounds above the atmosphere. In the "Clermont' of 1907, the boiler, in order to meet the government requirements, is built of steel, and carries twenty pounds pressure With these exceptions in mind the visitor to the Clermont' may be satisfied, both as regards the hull and the engines that she looks very much as she did on her first memorable trip up the Hudson Fulton s design, if we consider the crude condition of the art in those days, is creditable and it is a noteworthy fact that if we raise the bell-crank lever above the cylinder, we have an engine which is remarkably like the walking-beam engine of the present day Fulton, however, wished to keep his weights low in the boat, and the plan adopted is admirable for this purpose Two connecting rods from the crosshead are coupled to a bell-crank A-shaped pair of levers, from the top of each of which a connecting rod transmits the motion to a pair of crank spur wheels upon the inboard ends of the paddle-wheel shafts. In order to carry the engines over the dead centers, Fulton provided a pair of fly wheels which were carried upon separate counter-shafts, rotated by means of pinions secured at their inboard ends The air pump and feed pump are operated through connections from the bell-crank levers, as shown

About the correctness of the design of the replica of the hull of the "Clermont," there can be no doubt whatever The plans, drawn by Frank E. Kirby and J W Millard, are based upon a letter of Fulton's, which reads "My first steamboat on the Hudson River was 150 feet long, 13 feet wide, drawing 2 feet of water bow and stern 60 degrees", and upon the second enrollment of the "Clermont," on file in the New York Custom House, which describes the vessel as having "one deck and two masts," and gives her dimensions as 149 feet length, 17 feet 11 inches breadth, and 7 feet depth The enlargement in beam is due to later changes which were found necessary to increase the vessel's stability The "Clermont," as originally designed, had therefore a long narrow hull, with parallel sides, a V-shaped bow, and a stern which was V-shaped at and below the waterline, but above the water was carried out with a square overhang. This form was decided upon by Fulton as the result of towing experiments with models which he carried out himself, and he seems to have been of the decided opinion that this was the best form to secure the desired speed. She was provided with a limited amount of sail, of which, at least on her first trip, she seems to have made but little, if any, use. The paddle wheels, 15 feet in diameter were uncovered, and consequently, if any breeze were blowing, the passengers were pretty well drenched with water

Let it not for a moment be imagined that the public of that day had the least appreciation either of the genius of Fulton or the momentous character of the work he was doing. When, on Monday, August 17th, the little craft cast loose from her moorings near the old State's Prison, which stood on the square now bounded by Washington, West 10th, West, and Charles Streets, many of the thousands that lined the shore of the river had come to deride 'Fulton s Folly', and he made his preparations for the start to the accompaniment of jeers and catcalls At 1 o clock the hawser was drawn in, the throttle was opened, and then, amid the curious hush which immediately fell upon the multitude, the side wheels began to turn, and with Fulton at the helm the "Clermont" moved slowly out into midstream and headed north for Albany Skepticism gave way to approbation and delight, and amid thunders of applause the 'Clermont" moved slowly up the river, and was finally lost to sight in the upper reaches of the river At 1 o'clock on Tuesday the little vessel tied up at Clermont Dock, the landing for Chancellor Livingston s place, having covered the 110 miles from New York against the wind at an average speed of 4 6 miles an hour Resuming the journey at 9 o'clock on Wednesday morning, the "Clermont" reached Albany, 40 miles distant at 5 P M., the running time for the whole distance having been 32 hours, which gave an average speed of a little over 4½ miles per hour

We have shown in another chapter how phenomenal was the development of steam navigation on the Hudson River as inaugurated by this eventful trip, a development in which Fulton took a leading part. In 1812 he put his first ferryboat in commission, although to Stevens must be given the credit for having started a ferry to Hoboken in the previous year The boat, which was double-hulled, made her landings at a hinged, floating bridge, to which she was guided by lines of piling. Fulton was thus the originator of our present system of ferryboats. In 1810 we find him before President Madison explaining his models and plans for torpedo warfare In March, 1814, Congress authorized the construction of a steam war vessel to be built from Fulton's plans. This, the first steam warship in the world, was constructed with a double hull. Its dimensions were: Length 156 feet, breadth 56 feet, depth 20 feet. The paddle wheel, 16 feet in diameter, was driven by an engine, whose cylinder was 48 inches in diameter by 5 feet stroke As will be seen from our drawing, the sides of the "Demologos," as she was called, were strengthened by massing heavy timbers, until a thickness of five feet was reached She mounted twenty 32-pounder guns on the gun deck. Fulton, who was present at the launching of the vessel on October 29th, 1814, did not live to see her completed, indeed, it was his devotion to the work of her construction, which led him to spend many hours on her deck in the winter time, when he was troubled with a heavy cold, that brought about his death, which occurred February 23rd, 1815, at his home in what is now Battery Place. He was buried in the Livingston vault on the south side of Trinity Church, and to the northwest of the monument and tablet erected to his memory by the American Society of Mechanical Engineers in 1901.

Correspondence.

THE NUMBER OF OUR ANCESTORS.

To the Editor of the SCIENTIFIC AMERICAN

The search for truth is said to be often of more benefit than its attainment, and I am glad to see that a solution of the problem is beginning to emerge out of darkness, thanks to Mr Eckles's letter in your issue of August 21st, although it only lifts a corner of the curtain.

He proves what I have thought all along that people are far more closely related than is generally supposed, but there is another side to the problem he does not touch.

Consider the five or six distinct races of mankind, and the different nations of the world, such isolated people as the Japanese, Chinese, South Sea Islanders, Eskimo, Thibetans, and many detached tribes of India, Africa, and the other continents and islands. Must there not be thousands, not to say millions of people living to-day who have not the least commingling of blood in their veins for thousands of years at least?

Suppose we say that there are only twenty different people, a very conservative estimate, and take one from each as totally unrelated to the others for say one thousand years past, and reduce the number of their estimated progenitors (1 094 millions) to 10 per cent to meet Mr Eckles's blood relationship (a very generous allowance, as the isolation of groups works both ways, and tends to keep distant communities apart), and we arrive at 2,000 millions living at that date against the 1 500 millions of to-day

Los Angeles, Cal A. K VENNING

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WHAT IS HEAT LIGHTNING?

To the Editor of the SCIENTIFIC AMERICAN

I note in your issue of August 28th a communication from Mr A Graham of Topeka, Kan, regarding the classification of lightning I had the opportunity several years ago of proving that the so-called "sheet" or "heat" lightning is nothing more or less than a reflection, as he states of the regular "chain" lightning

I had a discussion with the man in the telegraph office in a small town on a railroad running directly east and west regarding what he called "heat" lightning I maintained that it was lightning flashes so far away or so high in the clouds, that we could neither see the flash itself nor hear the thunder

During the whole summer we watched the storms very closely, practically all of them came from the west, so we were able, by calling up the operators in the different stations, to tell just what was actually occurring, and in every single instance we could find other operators near us reporting "sheet" lightning while those at twenty five, thirty, forty, and even fifty miles off were reporting regular lightning, accompanied with thunder

It is the writer's opinion, based upon the observation of that summer that there is but one kind of lightning, viz., that which we see reaching from cloud to cloud or from cloud to earth when the storm is near by The same kind, in fact, that we can ourselves produce on a miniature scale between points of a spark plug in an automobile engine cylinder The appearance of so-called "heat" lightning is very easily produced on a cloudy or foggy night, by the jumping of a trolley wheel from its wire, thus making an arc that throws its reflection on the clouds.

Pontiac, Mich. A. R. WELCH

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HOW FINGER AND THUMB MARKS WERE DISCOVERED THROUGH A PHOTOGRAPHIC PROOF.

To the Editor of the SCIENTIFIC AMERICAN

A few weeks ago a photographic proof upon a piece of gelatine printing-out paper was given to the writer to tone with other photographic prints, in the usual chloride of gold and borax toning baths No particular attention was paid to this print It was treated the same as the others, namely, washed well, toned, fixed, and washed well again for half an hour

The prints were all squeeged upon thoroughly-cleaned ferrotype plates. When the prints were dry they were lifted in the usual way, by inserting the tip of a jack-knife blade at one corner, and pulled off. Every print came off perfectly clean, leaving no impression upon the ferrotype plate, except the proof that had been toned Upon examining the part where this proof had been dried, it was discovered that quite a number of mixed finger marks were clearly discernible upon the ferrotype plate, although not visible in the print. The explanation appears to be this Gelatine being a colloid body, the greasy matter, lactic acid, and sodium chloride contained in the perspiration of the skin became impressed and retained upon the gelatine surface, although not sufficiently to become visible to the human eye. Traces of lactate and chloride of silver being formed, became partly washed out previous to toning, and completely dissolved upon fixing, but the greasy matter remained. This too would become more perfectly retained when the gelatine came in contact with water, the result being that the greasy matter, not being affected by any of the chemicals used in toning and fixing, became manifest when the print dried down upon the ferrotype plate, leaving this greasy matter upon the japan, thus giving an admirable clue in the line of detection

New York, N Y A. J JARMAN

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ELECTRICAL FIREBALLS WHAT ARE THEY?

To the Editor of the SCIENTIFIC AMERICAN

This question, that I sent to the English Mechanic and which was published in that journal on July 30th page 618, letter 576, brought out a number of very interesting answers in subsequent numbers of the same paper, notably in those of August 13th and August 20th, and if your correspondent, Mr A. A Graham, who writes the article on Lightning' in the SCIENTIFIC AMERICAN for August 28th, will take the trouble to read the letters mentioned, in the English Mechanic, he may have occasion to modify his opinion regarding 'electrical fireballs."

Mr Graham says 'The recorded instances of fireballs are so rare and questionable, with no evidence of their electrical nature, that the information is not sufficient to enable one to form even a belief in their occurrence '

While entertaining very much the same belief as Mr Graham I received a letter from a very intelligent lady, who is spending the summer in a bungalow situated in the pine woods bordering on Buzzard's Bay, Massachusetts

She writes as follows "I was awakened about 2 o clock by hearing rain and rose to close the windows The darkness was appalling There was a flash of lightning and a loud peal of thunder, and as I got to the window I saw a luminous ball descending some distance away and when I looked again some minutes after there were numerous luminous bodies along the roof of a house about fifty feet away but these lights were stationary and I watched them till the first streaks of day"

Of course, we know very well what the immovable lights were The St Elmo fire an electrical appearance, is quite commonly seen on the masts and spars of vessels, and on projecting points of high buildings, but the fireball is a very different affair, and there seems to be abundant evidence of its occurrence that is if such scientific men as Arago Humboldt Flammarion and E B Dunn of the U S Weather Bureau may be considered good authority, and in addition to these, letter 59 in the English Mechanic of August 20th from Edwin Holmes, a member of the Royal Astronomical Society who describes a fireball that he witnessed himself may serve to satisfy Mr Graham that such things as fireballs are not entirely deceptive appearances and I would be very glad myself to hear from readers of the SCIENTIFIC AMERICAN what they know about them J D HYATT

New Rochelle, N Y

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DOES MUNICIPAL OWNERSHIP PAY?

To the Editor of the SCIENTIFIC AMERICAN

In your issue of August 21st second column on page 123, you speak of the effect that the electrifying of the London tramways has had on the passenger receipts of the Great Eastern Railway of England You make the following statement

"The Council Tramways are a municipal undertaking, and while giving good service have been run hitherto at a loss, the deficit being paid out of the rates."

As a matter of fact the report presented a few months ago by the London County Council on the results of the year 1907-8 showed that the gross receipts were £1,663,000 ($8 315 000), which was a surplus on working of £493,000 ($2 465 000) and a net surplus after payment of interest on capital outlay and providing for the repayment of debt of £45 406 ($227,030) The latter amount was carried to the renewals fund

There has been such a persistent attempt to depreciate municipal ownership throughout the United States, that it is hard to find justice given the subject. This attempt to mold public opinion through the press has been largely brought about by a "press bureau," maintained for that special purpose While I am personally of the opinion that municipal ownership in the United States would result in failure (because of the deplorable amount of graft and corruption in the administration of municipal affairs) yet it does seem as though municipal ownership *per se* should be given fair show ARTHUR J CRAMP

Chicago, Ill

EDITORIAL ADDENDUM TO LETTER.

We appreciate the tone as well as the substance of this correction, and regret that we had not noticed the later report quoted The note was based on a general impression, which was however correct as to the deficits in administration of the L C C. tramways in former years. While we are desirous of treating the question of municipal ownership as impartially as possible however we would point out that even in the report mentioned the net surplus was carried over to renewals fund with the probability that it would be more than used up in the ensuing year The only justification of municipal trading, in our opinion is that it should be carried on at a profit the *profit going to the relief of the rates* Since the above-mentioned surplus was not so used it can hardly be considered as a profit besides which it does not represent interest upon the capital expenditure of the Council at a rate upon which any private corporation could survive

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SUPERSENSITIVENESS OF THE BLIND

To the Editor of the SCIENTIFIC AMERICAN

In a recent issue of the SCIENTIFIC AMERICAN I noticed an article on the supersensitiveness of the blind in which cases were cited of remarkable acuteness of the remaining four senses The article in question calls to mind a notable experience I had in New York city in 1896

It will be recalled by thousands of people that the late Charles Broadway Rouss the blind merchant of that city offered one million dollars to anyone who would restore his sight The offer was sensational and was widely circulated in every civilized nation Thousands of letters, written in many languages, poured into the big Broadway store suggesting remedies, and the blind merchant was besieged by many offering treatments for the restoration of his sight Rouss although blind was a busy man always at his desk directing the affairs of his great establishment He was too busy to take treatments he declared and so he selected a substitute whose name was Martin and who was alike blind from atrophy of the optic nerve He was too poor to pay for treatments and was glad to act as a substitute for the millionaire who agreed to defray his expenses It was understood that Rouss would undergo any treatment that would benefit Martin

I made arrangements with Rouss for the treatment of Martin and accordingly Martin came to my residence every day for about two months The treatment was electrical from a primary battery of my own invention The files of the New York World of July 31st and Journal (since changed to American) of August 1st 1896 will show that my treatment of the case became quite sensational I believed that Martin had made some slight improvement and might regain his sight I finally gave up the case however deciding with all oculists that atrophy of the optic nerve is incurable

Martin was a native of New York city and had been blind nine years He was of a fearless and impetuous disposition and went about over the city without a guide He passed up down and across the great thoroughfares frequently and only a few times collided with a bicycle which vehicle he detested I was with him on occasions when I marveled at the perfect freedom with which he walked along the crowded streets showing not the slightest timidity and requiring no aid whatever from me

Once I left my residence on 22nd Street near Eighth Avenue with Martin for a walk through the city to Third Avenue and thence down town In passing he would name with great accuracy the streets and notable buildings His eyes showed no indication of blindness and no one suspected that he was blind I was amazed to see him cross Broadway at 14th Street with perfect ease and imagine my astonishment when he shied around some timbers that had been set up across a sidewalk to prop the wall of a building undergoing repairs. He got off and on street cars without a blunder and made his way across crowded streets without betraying his blindness. He used no cane nor did he feel his way with his hands Had I not known that he was actually blind I would have believed he was feigning.

I asked him how he knew his way and avoided collisions and he invariably told me he did not know He only knew that he cared nothing for his life and often remarked that he would rather be dead than blind He seemed to be guided by what I shall term a miraculous instinct superinduced by a subconscious mental condition I am inclined to the belief in the absence of a better theory that he was directed by what Hudson terms 'the subjective mind '

Arbuckle, Cal WALTER W FELTS

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Owing to the careful adjustment and regulation of temperature necessary in bacteriological incubators a new incubator has recently been built which will be heated by electricity and which it is expected will thus overcome the difficulties with gas-heated incubators Incandescent lamps are used in the new heater to maintain the required temperature A new mercury regulator controls the lamps. The instrument was tested quite recently for a run of forty five days, and the variations in temperature during this time were practically nothing The incubator is formed with a triple wall providing a water jacket and an air space and is covered with asbestos finished in white enamel

DEVELOPMENT OF THE HUDSON RIVER STEAMBOAT.

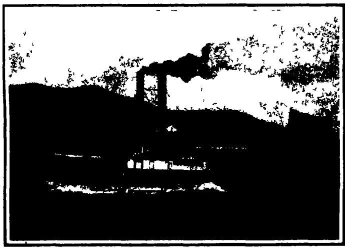
In that broad field of human activity which is covered by the term "engineering" there is probably no product of American design and construction that bears more distinctive national characteristics than the American river steamboat Also we venture the assertion that there is no type of passenger vessel plying upon river lake or ocean that presents such a perfect picture of graceful lines and contour or carries such a suggestion of speed as the American river steamboat. That it should show such undisputed beauty is surprising when we bear in mind that this type of boat has been developed during the past hundred years along lines of the strictest utility and under the stress of the most severe competition, a competition whose intensity has not been exceeded even in the construction of the competing railroads which have thrown their elaborate network over the face of the country Every one of the peculiar characteristics of the river steamboats has been due not to the mere caprice of the builder but rather to certain exacting physical conditions of the work which had to be done The shoal draft the wide overhanging guards, and even that distinctively American survival (we had almost said anachronism) the walking beam engine, are instances of "the survival of the fittest" after one hundred years of endeavor to find the best type of boat for this work

The successful trip of the "Clermont" to Albany in 1807, in the then incredibly brief time of 32 hours brought the new system of transportation into immediate favor and the growth of traffic, in spite of the fare of $7 for the single trip was such as to warrant the construction of four additional steamboats to meet the growing demand The "Car of Neptune" was built in 1808 the "Paragon" in 1811 the "Firefly" in 1812, and the "Richmond" in 1813-1814 It was not to be expected that so profitable a venture would be allowed to pass unchallenged and a company was formed at Albany which built two boats to run in opposition to the Fulton line. Fulton and Livingston, however were granted a perpetual injunction against the opposition company and the two vessels were turned over to Fulton and broken up Rendered thus doubly secure in the possession of their exclusive rights in the State of New York Fulton and Livingston took out additional patents and settled down to the development of the river carrying trade Not much is known of the four successors to the "Clermont" mentioned above beyond the fact that the weakness of construction which was evident in the "Clermont" was remedied The rectangular cross section was abandoned a keel and keelsons were introduced to give the longitudinal stiffness, the flat bottom was abandoned in favor of a dead rise, and the bilge was given the rounded form which characterizes the later vessels.

In 1811 Aaron Ogden Governor of New Jersey petitioned the New York Legislature against the Fulton monopoly, but was unsuccessful He built a steamboat called the "Sea Horse," to run between Elizabethtown N J and New York city and this vessel is credited by John H Morrison in his "History of Steam Navigation" with being fitted with an engine that was the pioneer of the American beam engine Subsequently Livingston and Fulton gave Ogden permission to run his steamboat on his ferry route for a period of ten years Out of this arrangement came the litigation ultimately carried to the United States Supreme Court by which the steamboat monopoly, which had existed for seventeen years, was broken One of the most active opponents of the Fulton Livingston interests was "Commodore" Vanderbilt, who in the early 20's was operating two boats the "Bellona" and "Stoudinger," from the Battery across the Bay to Elizabethtown, N J Robert R. Livingston, Fulton's backer and close associate, died in 1814, and Fulton on February 24th, 1815

There can be no doubt that the monopoly granted to Fulton served to delay the development both of the steamboat and of river transportation in general The decision of the Supreme Court in 1824 opened the river to steam navigation by boats propelled "by fire or steam," and forthwith the improvement of the steamboat began to go forward by leaps and bounds. The original North River Company was at once confronted by opposition lines The Hudson River Line built three boats, the "Constitution," "Constellation," and "Independence," and certain people in Albany set afloat the "De Witt Clinton" The year 1824 is notable for the launching of the first steamboat to carry compound engines the "Henry Eckford" The cylinders were 12 and 24 inches in diameter and the stroke 4 feet The new type of engine gave satisfaction, and it was used in several vessels, including the "Commerce" launched in 1825, of which we present an illustration and the "Sun" of about the same date The dimensions of the "Commerce" show the trend of development. She was of less length than the "Clermont," 130 feet as against 150 feet but of nearly twice the beam, the "Clermont" having been altogether too narrow for stability Her engines had cylinders 16 and 30 inches in diameter by 4 feet stroke Altered in 1852 and renamed "Ontario," this remarkable vessel was not finally broken up until the year 1894 The "Sun" whose engines were of the same compound model and of the same dimensions is credited with having made the trip from New York to Albany in the year 1826 in twelve hours and sixteen minutes, with thirteen landings so that in the intervening nineteen years since the voyage of the "Clermont," the time of passage had been reduced about two-thirds

The year 1826 is notable for the fact that John Ste-

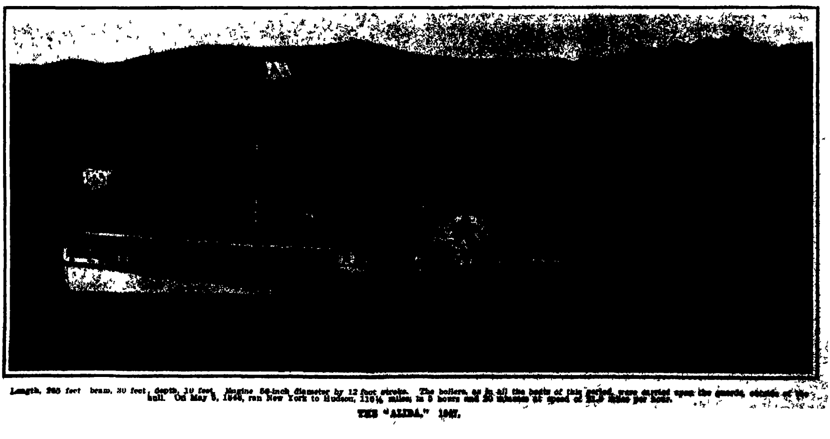


Length 130 feet beam 24 feet, depth 8½ feet Engines Cylinders 16 inch and 30 inch diameter by 4 foot stroke Altered in 1852 and renamed "Ontario." Broken up in 1894

THE "COMMERCE" 1825

Length 180 feet beam, 28 feet depth 9 feet Driven by two engines. Cylinders, 42 inch diameter by 10-foot stroke Carried two boilers on each guard In August, 1832 ran from New York to Albany in 9 hours and 40 minutes.

THE "CHAMPLAIN" 1832



Length, 265 feet beam, 30 feet, depth, 10 feet. Engine 56-inch diameter by 12 foot stroke. The boilers, as in all the boats of this period, were carried upon the guards, outside of the hull. On May 8, 1848, ran New York to Hudson, 115¼ miles, in 5 hours and 20 minutes at speed of [illegible] miles per hour.

THE "ALIDA," 1847.

vens, the Fulton monopoly having been broken, entered the Hudson River passenger business, and applied his genius to the design of engines and steamboats; and it is doubtful if anyone who worked at the problem in the first half century succeeding Fulton has left a deeper impress. Possessed of a natural gift for engineering and being a man of wealth and the owner of works of his own, he approached all problems from the scientific standpoint, carrying on careful experimental work before he started the construction of the full-sized engine or boat. To him we owe the present open-skeleton walking beam, with its inclosing wrought-iron strap. In his new "Philadelphia," 1826, he introduced the practice of carrying the boilers outside the boat upon the guards, and in her engine he introduced balanced poppet valves and wrought-iron side pipes. In the following year he introduced (in the "North America") for the first time the familiar truss or "hog frame" for stiffening the hull, a device which has survived in the Hudson River steamboat to the present day.

It was at about this time that the practice was followed in some of the steamboats of providing two separate engines, one for each paddle wheel. The "North America," above referred to had engines of this kind, as did the "Champlain,' 1832, which is shown in one of our illustrations. The "Champlain" also illustrates another point of current practice in the possession of four separate boilers, one carried forward and one aft of the wheel house on the guards on each side of the vessel. The 'four-pipe boats' with their two oscillating walking beams must have presented an odd appearance to the people of that day, who were accustomed to the one- and the two-pipe practice of the previous years. The next vessel to make a considerable cut in the running time to Albany after the performance of the 'Sun" was the Novelty" which on May 31st, 1832, ran from Albany to New York in nine hours and forty-seven minutes. On August 23rd of the same year, the "Champlain' made the run north in nine hours and forty nine minutes.

The period from 1830 to 1840 was marked by a truly wonderful development in the speed of the Hudson River steamboat. At that time there were no steam vessels anywhere in the world that could approach these famous craft in speed and that American shipbuilders and engineers should have gained such a commanding lead over the Old World is to be attributed to the facilities afforded by our magnificent rivers, to the keen competition between the various companies and to the fact that then as now it is the fastest means of conveyance that wins the popular favor. Two of the swiftest boats of the day were the 'Swallow" which was built for the original North River line and the Rochester built in the same year, 1836, for the People's Line which was started in 1835. The "Swallow after frequent alterations to engines and hull with a view to increase of speed was finally equipped with a cylinder of the huge diameter for those days of 52 inches and the Rochester with one of 50 inches diameter. The particulars of these boats as given by Morrison show to what an advanced stage

(*Continued on page 227.*)

As originally built in 1861: Length was 280 feet; beam, 34½ feet, depth, 10½ feet. Engine Cylinder, 62 inch diameter by 12-foot stroke. Vessel rebuilt in 1875 and 1881. On August 7th, 1874, ran from New York to Poughkeepsie 74¼ miles, in 3 hours and 19 minutes at speed of 22.54 miles per hour.

THE "MARY POWELL." 1861

As originally built in 1880. Length, 285 feet, beam, 40 feet, depth, 11½ feet. Cylinder 75-inch diameter stroke, 12 feet. Subsequently lengthened to 325 feet. Has feathering paddle wheels. On October 22d, 1880, ran from 22d Street New York to Poughkeepsie 72¼ miles in 3 hours 8 minutes at speed of 23.28 miles per hour. The "Albany" and the "New York" were the first large Hudson River boats to be built of iron.

THE "ALBANY" 1880

Length, 412 feet, beam, 50 feet, draft, 8 feet. Beam engine, cylinder, 81 inch diameter, 12 foot stroke. Horse-power 3,800. Speed maximum 20½ miles per hour. Contains 350 state rooms. The dining-room can seat 300 guests. There are four decks for the accommodation of passengers.

THE "ADIRONDACK" FOR NIGHT SERVICE. 1896

Length, [illegible] feet; beam, 48 feet; width over guards, 82 feet, draft, 7½ feet. Inclined engine, one 45-inch high pressure, two 70-inch low pressure cylinders, with 7-foot stroke. Steam, 170 pounds. Speed on trial trip, 24.5 miles per hour. Has six decks, four of which comfortably accommodate 5,000 passengers.

THE "HENDRICK HUDSON," 1906. DAY SERVICE.

Length 348 feet, beam 42 feet, draft 7½ feet. Beam engine cylinder 75 inch diameter by 12-foot stroke. Has feathering paddle wheels. This vessel has the finest underwater body of all the Hudson River boats. Her maximum speed is 23½ knots.

THE "ROBERT FULTON" 1909 DAY SERVICE.

AMERICAN STEAMBOATS PRIOR TO THE "CLERMONT."

It is one of the estimable qualities of Robert Fulton that in spite of the obvious temptation so to do, consequent upon his brilliant success with the Clermont he never claimed the distinction of being the original inventor of the steamboat He was perfectly familiar with the ingenious work in the development of steam navigation which had been done both in the United States and in Europe during the two decades preceding the successful trip of the Clermont He had intimate knowledge of the previous history of the art, he was personally acquainted with the more successful inventors, and as a guest had made trips on at least one of the more successful boats The present celebration so far as Fulton is concerned is held in honor of the *successful inauguration of practical commercial steamboat navigation on the Hudson River* There is glory enough surely in this to make a fitting crown for the life work of one man Were Fulton in our midst to-day he would be among the first to do justice to the work of his predecessors and contemporaries in other times and on other waters

It is impossible within the limits of the present article to describe at any length the dozen or more steamboats big and little which were built and tried with *varying degrees of success in America prior to* 1807 We must content ourselves with the following summary (based on Preble's history) of these early efforts followed by a brief sketch of the remarkable work of Fitch and Stevens

The first boat successfully propelled by steam in America was one built by John Fitch which was tried on the Delaware July 27th 1786

The second American steamboat also built by Fitch was tried on the Delaware in 1787

The third boat built by James Rumsey and driven by a water jet was operated at Shepardstown on the Potomac September 3rd 1787

The fourth steamboat built by Fitch ran from Philadelphia to Burlington in 1788

The fifth steamboat also built by Fitch, made eight miles an hour over a measured course at Philadelphia in 1789, and in 1790 was placed in regular service on the Delaware as a packet, its sailing dates being advertised in the local press.

The sixth steamboat, a stern-wheeler, built by Capt. Samuel Morey of Connecticut, sailed from Hartford to New York, with Chancellor Livingston and others on board in 1794

The seventh steamboat, by Fitch, tried on the old Collect Pond now the site of the Criminal Court building and City Prison, New York, was driven by both paddle wheels and a screw propellor Chancellor Livingston was aboard on this trip and a very crude model of the boat shown in the accompanying illustration is now in the keeping of the New York Historical Society

The eighth boat by Morey, was tried on the Connecticut River in 1797

The ninth steamboat was built to plans of Chancellor Livingston by a Mr Nisbet, and tried at De Koven's Bay south of Tivoli in March 1798

The tenth steamboat was a model side-wheel vessel built by Fitch and tried on the Ohio in 1798

The eleventh boat built and designed conjointly by Nicholas Roosevelt, John Stevens, and Chancellor Livingston, had side chain wheels driven by a steam engine. It was tried successfully in October, 1798, and with the Spanish Minister on board as a guest made three miles an hour

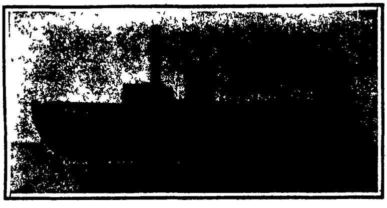
The twelfth steamboat, built by Col. John Stevens, was a 25-foot flat-bottomed boat, which was driven by a screw propeller on the Hudson River at a speed of four miles per hour in 1803 and 1804.

The thirteenth steamboat, built in 1804 by Stevens, was propelled by twin screws at a speed of seven to eight miles per hour, and made several trips on the Hudson River

The fourteenth steamboat, built by Oliver Evans in 1804 was a large scow, or lighter, driven by a paddle wheel at the stern.

The fifteenth and last steamboat before 1807 to make a trip under her own steam was a large pirouge, with side paddle wheels, called the "Phœnix," built by Stevens in 1806-7, which, being debarred by Fulton's monopoly from navigating on the Hudson, subsequently steamed to Philadelphia by sea, and thus became the first steamship to make an ocean voyage.

It should be understood that although the above enumeration includes vessels that were actually moved by steam, no claim is made that they were all of a practical character Of the Americans who turned their attention to the development of the steamboat in the pre-'Clermont' period two men, in our opinion stand head and shoulders above their competitors, namely, John Fitch and John Stevens, the first, for the reason that as far back as 1790 he placed on the waters of the Delaware a steamboat which ran on a regular schedule, was advertised extensively in the local papers, and carried freight and passengers at specified fares, the latter, because he was the first to apply the screw propeller as the sole means of propelling a boat, that he used tubular boilers and high-pressure steam, and that he was the first to adopt that system of twin propellers which subsequently became the standard method of propulsion throughout the world.



Rumsey's boat was propelled by a steam engine and pump which drew in water through the bottom and discharged it in a jet at the stern Made four miles an hour in a short trial on the Potomac but never reached the stage of practical operation

(From photograph of the model in the Smithsonian Institution taken especially for the Scientific American)

JAMES RUMSEY'S STEAMBOAT OF 1787

This boat made six miles an hour on the Delaware It was propelled by vertical paddles driven in sets of three by side rods operated by a steam engine

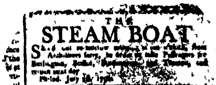
(From photograph of the model in the Smithsonian Institution)

JOHN FITCH'S STEAMBOAT OF 1787

This crude model was made from memory in 1852 by a witness of the trials of the boat on the old Collect Pond New York city

(From photograph of the model at the New York Historical Society)

JOHN FITCH'S STEAMBOAT OF 1796

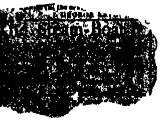


THE
STEAM BOAT

Photograph of advertisement in the "Federal Gazette" of Philadelphia July 26th, 1790

This boat, 60 feet long driven by an engine with cylinder 18-inch diameter, designed and built by Fitch, was put in regular service, advertised in the Philadelphia papers, and for three months in 1790 sailed according to schedule between Philadelphia, Trenton, and way points. Its average speed was 7 miles an hour. It was propelled by paddles at the stern.

JOHN FITCH'S STEAMBOAT, WHICH SAILED REGULARLY BETWEEN PHILADELPHIA AND TRENTON IN 1790

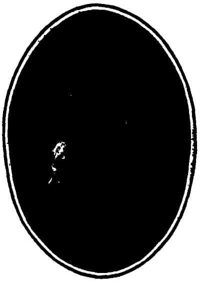


Photograph of advertisement in the "Pennsylvania Packet" of Philadelphia of June 14th, 1790.

JOHN FITCH.

John Fitch stands out as a splendid type of a large class of ingenious, courageous, but poor inventors, who did so much to promote the industrial development of the country during the early years of the young republic. Born at

Windsor, Conn., on the 21st of January, 1743, in moderate circumstances, he learned the trade of clock making, and at twenty-six years of age moved to New Jersey and then to Philadelphia, where he became a strong partisan on the American side in the dispute between the colonies and Great Britain. He was made lieutenant of a company raised at Trenton, but ultimately he found his sphere of usefulness in the gun factory at Trenton When Washington crossed the Delaware Fitch moved with the Continental troops to Pennsylvania. In 1780 he was appointed a deputy surveyor, and ultimately struck out westward for the purpose of surveying lands lying beyond the Ohio River In 1781 he started for Fort Pitt, now Pittsburg Later he was captured by the Indians, endured severe privations, and was finally carried by them to Canada, where he fell into the hands of the British After his liberation he again took up the work of surveying the unknown lands of the West, and ultimately in 1785, turned his attention to his great life-work of inventing a boat to travel by the power of steam Beyond a natural aptitude for mechanics, Fitch was entirely unfurnished for this difficult task Although steam-engine building was a recognized trade in England and had been for many years, there were at this time but three steam engines in the whole of America, and the country was absolutely without suitable means for steam engine manufacture In his quaint 500-page manuscript autobiography now in the Philadelphia Library, Fitch writes "Although it was not to my credit, I did not know that there was a steam engine on earth when I proposed to gain a force by steam" He read up all the scant literature he could obtain on the subject formulated his plans and on September 27th 1785, presented a drawing and model of his boat to the American Philosophical Society at Philadelphia The model shows the method of propulsion by an endless chain provided with paddle boards He endeavored to interest Franklin and Gen Washington in his plans, neither of whom however gave him much encouragement. He formed a company and on March 18th, 1786, secured from the Legislature of New Jersey the exclusive rights for steam navigation in that State It was at this time that he associated himself with Henry Voight a clock maker of unusual mechanical ingenuity and skill The task which these men had set themselves was Herculean There were no machine shops nor the necessary tools for the accurate work required, and through the subsequent years of experimentation they had to feel their way amid a thousand discouragements of poverty and ignorance, to the final success which crowned their efforts five years later They first built a model steam engine with a cylinder of one inch diameter which was too small for a demonstration Then a new model with a 3-inch cylinder engine, was erected in a small skiff, and a trial was made with Fitch's endless chain paddle-boards but without success. Then it occurred to Fitch to move the boat by oars or paddles, working on the side, and moved by cranks operated by the engine This was tried on the skiff with the 3-inch engine and on the 27th of July, 1786 the first boat propelled by steam in America made its trial trip successfully on the Delaware. Encouraged by the passage of a law by the State of Delaware in 1787, securing Fitch's right to the invention, fresh advances of money were made by the shareholders, and a boat 12 feet wide and 45 feet long was equipped with an engine having a 12-inch cylinder After much experimental work with the condensers, this boat, on August 22nd 1787, was propelled on the Delaware in the presence of practically all the members of the Convention who were then sitting in Philadelphia to frame the Federal Constitution Certificates of perfect success of this trial were given by Gov Randolph of Virginia David Rittenhouse the astronomer and other notable men An engraving and description of the boat made from the plans were published in the Columbian Magazine for December 1786 The cylinder was double-acting and condensing. Fitch introduced the jet condenser which he believed to be original with him, although it had been previously invented in Europe The boat was driven by six pairs of oars or paddles which were pivotally connected in sets of three to four horizontal driving bars, operated by cranks on crank disks driven by the engine. Fitch preferred these paddles to the paddle wheel, because he considered that the latter involved a great waste of power due to the obliquity of the wheels on entering and leaving the water Fitch's objection to the paddle wheels was theoretically correct, and its inefficiency was not corrected until the invention half a century later of the feathering paddle wheel



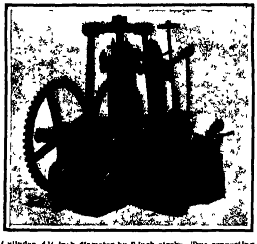
Col. Stevens built the first successful steamboat driven entirely by the screw propeller, the first twin propeller boat and the first steamboat to make an ocean voyage

COLONEL JOHN STEVENS, 1749 1838

The third steamboat built by Fitch was a much larger craft and was driven by a greatly improved engine The new boat was 60 feet in length and 8 feet in beam Its engine also had 12 inch cylinder but as the result of an improved condenser designed by Fitch it developed considerably more power than the engine in the preceding boat Furthermore it should be mentioned that this was the first steam boat equipped with a tubular boiler the invention of Voight The oars, or paddles were removed from the sides and placed at the stern Toward the close of July 1788 she made the trip of twenty miles from Philadelphia to Burlington and on the 12th of October she made the same trip in three hours and ten minutes with thirty passengers on board The boat continued in more less experimental operation during 1788 and 1789 The story of the troubles of Fitch and Voight in the endeavor during this time to perfect their engine as contained in Fitch's autobiography is of absorbing interest No less than seven different condensers were tried and rejected Finally an 18-inch steam cylinder and a jet condenser of Fitch's design were installed and at last in the words of Fitch On the 16th of April (1790) got our work compleated and tried our Boat again and altho the wind blew very fresh at the north east we reigned Lord High Admirals of the Delaware and no boat in the River could hold its way with us, but all fell astern although several sail boats which were very light and heavy sails, that brought their gunwales well down to the water came out to try us

Shortly afterward Rittenhouse the astronomer Dr Ewing Gen Irvine and others were favored with the novel experience of a steam voyage, and now at last public journals began to give well deserved notice to the successful efforts of these indefatigable inventors The following paragraph was published in the Gazette of the United States May 15th 1790 and widely recopied throughout the Union Burlington May 11 1790 The friends of science and the liberal arts will be gratified in hearing that we were favored on Sunday last with a visit from the ingenious Mr Fitch accompanied by several gentlemen of taste and knowledge in mechanics in a steamboat constructed on an improved plan From these gentlemen we learn that they came from Philadelphia in three hours and a quarter, with a head wind the tide in their favour On their return by accurate observations they proceeded down the river at the rate of upwards of seven miles an hour' Subsequently on June 16th Gov Thomas Mifflin and nine members of the

(Continued on page 222)



Cylinder, 4¼ inch diameter by 8-inch stroke Two connecting rods to two shafts which are geared together and turn in opposite directions Valves are two-way cocks operated by a crank on inboard end of one of the crank shafts.

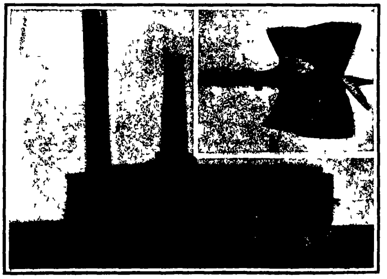
ENGINES OF STEVENS'S TWIN SCREW STEAMBOAT OF 1804.

Round shank could be turned in the hub to change pitch

STEVENS'S ADJUSTABLE PROPELLER BLADES

Debarred by the Livingston-Fulton monopoly from navigating the Hudson, the "Phoenix" went by sea to Philadelphia and was operated on the Delaware. (This was the first steamboat to make an ocean voyage)

STEVENS'S STEAMBOAT THE "PHOENIX," 1807.



Boiler has 28 tubes 1½ inch diameter and 18 inches long fourteen projecting from each side of the central rectangular chest
(From photograph by the courtesy of the Smithsonian Institution.)

MULTI-TUBULAR BOILER AND TWIN SCREWS OF THE STEVENS BOAT OF 1804.

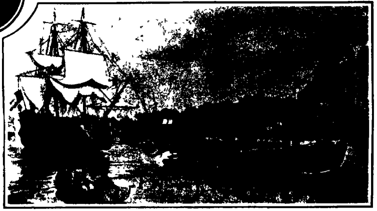


Fig 1 JONATHAN HULLS'S PROPOSED BUT NEVER BUILT STEAM TUG 1737

Fig 2—THE MARQUIS DE JOUFFROY'S PADDL[illegible]STEAMBOAT ON THE SAONE JULY 15TH, 1783

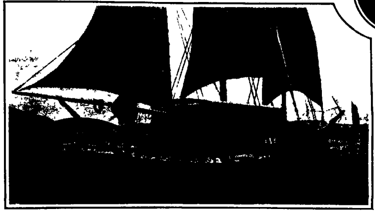


Fig 3 PATRICK MILLER'S DOUBLE-HULLED PADDLE BOAT DRIVEN BY MAN POWFR 1786

Fig. 1.—In 17[illegible] Jonathan Hull[illegible] [illegible] Camp[illegible] [illegible] [illegible]stershire, patented and published a [illegible] [illegible] of a practical steam tu[illegible]. The tug had a single acting steam cylinder [illegible] inches in diameter, which in its downward stroke lifted a weight equal to one-half [illegible] [illegible] the pull. The [illegible] weight in its descent during the return stroke gave the engine a double action, and the reciprocating motion of the piston gave continuous rotation by a ratchet gear to a paddle wheel at the stern.

Fig. 2.—The drawing [illegible] [illegible] South Kensington Museum taken from a French print published in 1816. [illegible] [illegible] and commented [illegible] that on July 1[illegible], 1783, the vessel was propelled by steam for fifteen minutes against the current of the Saone. The boat was [illegible] long, with [illegible] beam and [illegible] inches draft. It had two paddle wheels [illegible] horizontal steam cylinder driving through a ratchet [illegible] [illegible].

Fig. 3.—Patrick Miller, a wealthy Scotch banker, built a double-hulled boat which he propelled by [illegible] wheels placed in the channelway between the hulls and operated by men by means of cranks and winches. Symington [illegible] [illegible] substituted steam for man power.

Fig. 4.—The vessel designed by Symington for the Forth and Clyde canal in March, 1802, towed two 70-ton barges [illegible] miles against a hard wind at the rate of 3[illegible] miles an hour. The horizontal [illegible] [illegible] paddle wheel shaft was many decades ahead of the time. It [illegible] all the essential features of the modern horizontal engine [illegible] [illegible] [illegible] [illegible] that day.

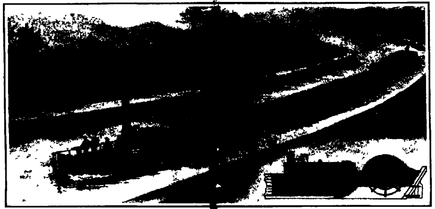


Fig 4 WILLIAM SYMINGTON'S STEAMBOAT "CHARLOTT[illegible]UNDAS" TOWING ON THE FORTH AND CLYDE CANAL 1802

Fig. 5.—The engine for this boat was built in 1788 by William Symington for Patrick Miller. It was placed on one deck of a double-hulled pleasure boat, and the boiler was placed on the other deck. The boat ran on Dalswinton Loch at the rate of five miles an hour. The engine had two vertical open-topped cylinders with pistons [illegible] by two chains with a drum turning in opposite directions alternately. [illegible] two pulleys attached to the horizontal paddle shaft [illegible] flanges, and these drove the paddle wheel continuously in one direction.

Fig. 6.—The hull of this vessel was built [illegible]. The horizontal motion [illegible] was converted into circular motion by [illegible] a long [illegible]. The floats of the paddle were arranged [illegible] parallel [illegible] [illegible].

Fig. 7.—This illustration is drawn from plans and data [illegible] with the [illegible] [illegible]. That his boat [illegible] formed the model on which the engines of the Clermont were [illegible]. It consisted of an upright cylinder [illegible] vertical [illegible] from which the paddle wheel crank shaft was driven [illegible] [illegible] miles on its trial trip.

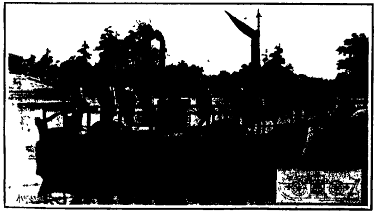


Fig 5—SYMINGTON AND MILLER'S DOUBLE-HULLED STEAM VESSEL 1788.

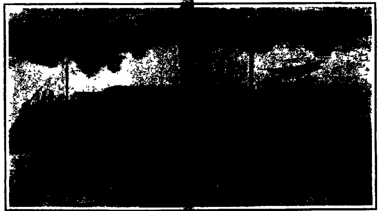


Fig 6.—DESBLANCS' STEAMBOAT [illegible]ED ON THE RIVER DOUBS 1809

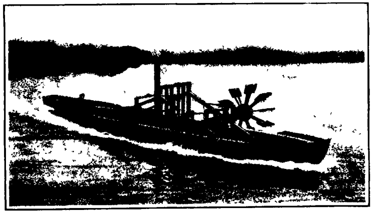


Fig 7 FULTON'S STEAMBOAT BUILT AND TRIED ON THE SEINE AT PARIS JULY 1803

EUROPEAN STEAMBOATS [illegible]IOR TO THE "CLERMONT."

Figs. 4 and 7 by our own artist; the other[illegible] the courtesy of the Illustrated London News.

[SEE PAGE 222.]

EUROPEAN STEAMBOATS PRIOR TO THE "CLERMONT."

As in America, so in Europe, the quarter of a century preceding the successful inauguration of steamboat service on the Hudson River was a period of *extraordinary interest among inventors in the possibilities* of steamboat navigation, during which a great amount of thought and experimental work was devoted to the development of a successful steam-driven vessel In the present chapter we shall touch lightly upon those inventors who merely drew up plans took out patents, and made more or less successful models of steamboats our attention will be devoted more specifically to the clearly recorded and well-authenticated instances in which steamboats of useful size were actually propelled by steam

Following this plan, we may dismiss at once the oft-asserted claim that a vessel of some 200 tons, built by Blasco de Garray a native of Biscay, was propelled by steam at Barcelona in Spain in the year 1543 Careful search by investigators has revealed two letters signed by Garray and dated 1543, describing experiments with different vessels both of them moved by paddle wheels *turned by men* There is no mention of the use of steam or anything to indicate that this motive power was contemplated

The Marquis of Worcester published a book in 1663 in which mention is made of an engine and of the ability of the inventor to make the vessel which carried it go against the stream which the more rapid it is the faster it shall advance" His patent, however contains no suggestion that he had any idea of using steam

Although the name of no inventor in the early part of the eighteenth century is more closely associated with the design of the steamboat than that of Jonathan Hulls *there is no proof* that he ever built and operated one At the same time Hulls was a man of unusual intelligence and of considerable mechanical skill His patent taken out in 1736, describes the invention as a machine for carrying ships and vessels out of or into any harbor or river against wind and tide The following year he published a pamphlet in London describing his invention and it is curious that, like many early experimentalists, he considered that its greatest usefulness would be found in the towing of vessels The illustration of his boat, given on page 220 was drawn from his very complete description of the mechanism of the boat and Admiral Preble of the United States navy in his work 'On the Origin and Development of Steam Navigation, says that there can be no doubt of his having been the first inventor of an ingenious and practicable mechanism for propelling vessels by a condensing steam engine and by paddle wheels and this be it remembered was as far back as 1736 Writing over a quarter of a century ago again the same author says The following doggerel is still the burden of a common street ditty among the boys of Campden of Gloucestershire, Hulls s native place

Jonathan Hulls,
With his patent skulls,
Invented a machine
To go against wind and stream,
But he being an ass,
Couldn t bring it to pass,
And so he was ashamed to be seen'"

Truly a prophet is not without honor save in his own country

It is a disputed point whether to Denis Papin, the great French engineer and professor of mathematics at the University of Marburg is due the credit of being the first to make a steamboat run upon a public waterway Preble however is of the opinion that his correspondence with Leibnitz, which was brought to light during the latter part of the nineteenth century, fully proves that Papin actually constructed a steamboat which he ran upon the river Fulda in 1707 It is certain that he met with the seemingly inevitable ridicule and abuse Disgusted with the conduct of the Hessians he determined to go to London in his steam vessel and descended the Fulda as far as Munden where the boatmen laid violent hands upon him, and destroyed his little craft

Next to Papin comes the Marquis de Jouffroy who in 1781 built a steam vessel 150 feet in length and 15 feet in beam which according to a document now in Paris was propelled by steam for fifteen minutes against the stream

WILLIAM SYMINGTON

The credit for the invention and construction of the first steamboat to be successfully applied in Europe to useful navigation is due a Scotch engineer, William Symington, who attacked the problem on original lines, and produced a vessel the "Charlotte Dundas," which in many respects was half a century in advance of the state of the art Symington was born in Scotland in 1764 Educated for the church, his taste for mechanical philosophy, he tells us, led him to direct his studies to the exercise of the profession of a civil engineer He obtained patents for several improvements in the steam engine, and designed a steam carriage, which in 1786 he submitted to several learned and scientific men in Edinburgh. Here he met Patrick Miller of Dalswinton, a wealthy banker, who informed Symington that he had "spent much time in making experiments as to the propelling of vessels upon water by using wheels in place of sails or oars. These wheels he had put in motion, applying the strength of men to the turning of a handle or winch." Symington told Miller that he believed a steam engine might be constructed for the purpose, and he proposed that favorite method with early steamboat inventors, of communicating a rotary motion to the paddle by the alternate action of ratchet wheels. The first experiment was made with a two-cylinder engine, the cylinders being of 4 inches diameter and 18 inch stroke. It was installed on a double-keel vessel, and tried on the Dalswinton estate in 1786, with satisfactory results. The next experiment was upon a larger boat, 60 feet in length, belonging to Miller, which was already equipped with man-operated paddle wheels. In this vessel Symington placed a two-cylinder engine, each cylinder being of 18 inches diameter and 3 foot stroke, and in October 1789, with Miller and several prominent business men and engineers on board, the boat was driven at a *rate of five miles an hour in still water* The engraving on page 220 is based on the original plans of this boat, as given by Symington. At this point, Miller retired from business to devote himself to his estate at Dalswinton, but in the year 1800 Lord Dundas, one of the principal owners of the Clyde Canal requested Symington to take up his experiments with the steamboat, and spent about $35,000 in this work With sufficient capital assured to give him a free hand, Symington designed an entirely new boat and engine called the "Charlotte Dundas" An examination of the drawings of the vessel, as shown on pages 220 and 221 of this issue proves that Symington was an engineer of decidedly original genius. Even at that early day, his mechanical sense objected to the cumbersome overhead working beam and in a letter at that period he criticises the cylinder erected in a vertical position and the heavy working beam, and other heavy and complicated apparatus of the old steam engine and explains how by changing the position of the cylinder and 'by coupling to the end of the piston rod a crank and arm,' he 'reproduced a rotary motion without the intervention of a lever or beam ' In other words, Symington in the engine of the "Charlotte Dundas originated the modern horizontal reciprocating engine which was destined to become the predominant type for steamboat locomotive and stationary engines and continued to be such throughout the middle period of the history of the steam engine The cylinder was double acting 22 inches in diameter and with a stroke of 4 feet It was direct-connected to the crankshaft of a paddle wheel at the stern of the boat The account of the experiment as given in his own narrative which has been confirmed by others, is as follows

Having previously made various experiments, in March, 1802 at Lock Twenty-two, Lord Dundas, the great patron and steamboat promoter along with Archibald Spiers Esq., of Elderslee and several gentlemen of their acquaintance being on board, the steamboat took in drag two loaded vessels the 'Active' and *Euphemia,' of Grangemouth* Gow and Elspine, masters, each upwards of *seventy tons* burden, and with great ease carried them through the long reach of the Forth and Clyde Canal at Port Dundas, a distance of nineteen and a half miles, in six hours, although the whole time it blew a very strong breeze right ahead of us, so much that no other vessel could move to windward in the canal that day but those we had in tow"

Since the object of Lord Dundas in employing Symington was to have him devise some cheaper means of towing canalboats than the existing method by horses, it would look as though the future of the steamboat was assured but, unfortunately, the other proprietors of the canal objected to the use of steamboats, urging that the waves set up would wash away the canal banks. Therefore, nothing further was done Subsequently Symington was introduced by Lord Dundas to the Duke of Bridgewater, who was responsible for the introduction of canals into England Symington impressed him so favorably that he gave him an order to build eight boats similar to the "Charlotte Dundas" for service on his canals, but the death of the Duke shortly afterward led to the canceling of the order

Among the many methods of applying the power of the engine to propel the boat that were tried by the early inventors one of the most popular was to use an endless chain of paddle boards, traveling over wheels or pulleys at each end of the boat, the paddles being submerged as they passed toward the stern, and being carried clear of the water as they returned toward the bow Of this type was Desblanc's steamboat, which was tried on the river Doubs in 1802. The arrangement of the engine and the chain of paddles is shown very clearly in the engraving on pages 220 and 221. The engine was horizontal, and the reciprocating motion of the piston was converted into rotary motion by means of a ratchet gear acting upon a spur wheel upon the main driving axle.

AMERICAN STEAMBOATS PRIOR TO THE "CLERMONT."

(*Concluded from page 219*)

Council, after a trip on the Delaware, were so greatly pleased as to present Fitch with a suit of colors for his boat.

The new venture was now ready for commercial exploitation. A schedule of sailing dates and fares was drawn up, and during the following three months there appeared in the local papers twenty-three advertisements announcing the times of sailing. The routes covered were to Trenton, thirty miles, to Burlington, twenty, to Chester, fifteen, and to Wilmington, thirty miles During these three months "The Steamboat," as she was popularly called, ran in regular passenger service for a total distance of between 2,000 and 3,000 miles. Limitations of space prevent any further quotation of the certificates and eulogies given by prominent men of the day We present engravings of two of the advertisements of 1790, photographed for the SCIENTIFIC AMERICAN from the files of the Pennsylvania Packet and the Federal Gazette, by the courtesy of Mr Abbott, the curator of the Philadelphia Library,

In view of this crowning success to the labors of Fitch and his associates, the story of the rest of his life is truly tragical. His attempt to build another and larger vessel failed for want of financial support. Had some influential, wealthy, and far-sighted patron come to Fitch's assistance at this time, there can be little doubt that the advent of successful commercial steamboat navigation would have been hastened by twenty years. But it was not to be Discouraged and embittered by failure to secure recognition and support, Fitch after an abortive trip to France, wrote an account of his life and experimental work, which he delivered to the librarian of the Philadelphia Library with instructions that it be not opened for thirty years, and then, retiring to Bardstown, Ky, he ended his unfortunate life by committing suicide.

JOHN STEVENS.

The claim of Col John Stevens to a foremost position among those who contributed to the early development of the steamboat is based upon his recognition of the value of the screw propeller, of the multitubular boiler, and of high pressure steam Like Fitch, Stevens was possessed of great mechanical ability, and to this was added the advantage of wealth and education. His claim to have built the first steam screw propeller boat to navigate the waters of any country we consider to be indisputable.

After some preliminary experiments, as recorded earlier in the present chapter, Mr Stevens designed an entirely new engine and boiler, differing from anything that had yet been attempted either here or in Europe and erected it in a 28 foot boat, which made many successful trips at speeds of between seven to eight miles an hour on the Hudson River The twin screws, engine, and the boiler are still in existence and are now at the Smithsonian Institution, Washington The accompanying illustrations are reproductions from photographs of this exhibit made especially for the SCIENTIFIC AMERICAN by the courtesy of the curator The cylinder was of 4½ inches diameter and 9 inches stroke Motion was transmitted from the overhead crosshead by two connecting rods to a pair of cranks, one on each propeller shaft. The cranks turned in opposite directions (to overcome the tendency of a single propeller to rotate the boat) and the cranks were maintained in their proper rotating position relatively to each other by means of two gear wheels on the propeller shafts. The reaction of the connecting rods against each other served the purpose of a parallel motion and maintained the piston rod in alignment. The valves consisted of two-way cocks, and they were driven by a crank on one of the propeller shafts, through the intermediary of a vertical rack and gear wheels on the spindles of the two-way cocks. The boiler is one form of the multitubular type invented by Col. Stevens. It has 28 copper tubes, 14 projecting from each side of a center rectangular chest.

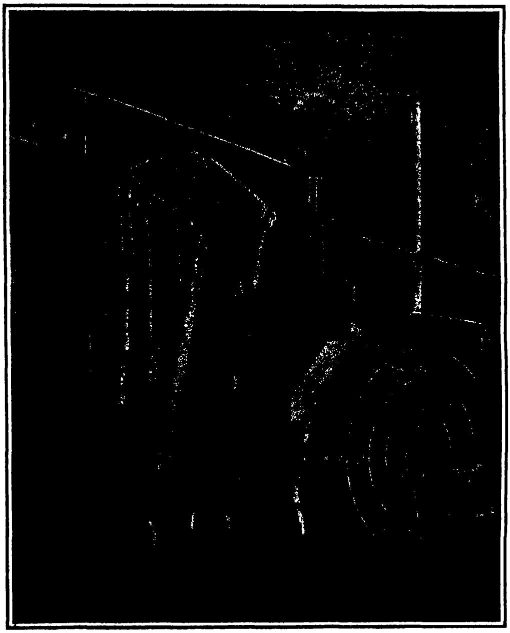
Contemporary testimony to the successful operation of this boat is given in Stewart's "Anecdotes of the Steam Engine," published in 1829, and in an article by Dr James Renwick contributed to Tredgold's "Treatise on the Steam Engine," published in London in 1838.

That John Stevens and his son, Robert L. Stevens, are to be credited with having built the first ocean-going steamship is proved by the well-authenticated voyage made by the "Phœnix" from New York to Philadelphia. The engines of the "Phœnix" were designed and built by Stevens. The accompanying illustration of this historic vessel is from a photograph of an old painting at the family home, Castle Point, Hoboken, N. J. Alluding to the above voyage, the late Mr. J Scott Russell, the builder of the "Great Eastern," said that Mr. Robert L. Stevens was "undoubtedly the pioneer of steam navigation in the open sea."

THE AMERICAN WALKING-BEAM ENGINE.

Looked at from the standpoint of the mechanical engineer, the most extraordinary fact in the story of the development of the Hudson River steamboat is the vitality of that early form of steam engine known as the walking-beam type. Although to-day its term of useful life lacks but a year or two of a century and it is, therefore, actually as old as the Hudson River steamboat itself, and though it represents one of the earliest and crudest methods of changing the reciprocating movement of the piston into the rotary movement of the power shaft, the walking beam engine is to-day the prevailing type of drive on the Hudson River Most significant fact of all, when it came to the question of what type of engine to use on the 'Robert Fulton," the latest of the Hudson River fliers, built this year, it was decided that, all things considered, the most suitable engine would be one of the kind which was first placed in a Hudson River boat in the year 1811.

In steam engine practice, one hundred years ago, the rocking or walking beam was the favorite method of connection between the piston rod and connecting rod We are all familiar with the engravings of early stationary engines, particularly those used for pumping in city waterworks, in which a vertical steam cylinder transmitted its power to a cast-iron overhead rocking beam, which was carried upon cast iron girders supported on cast iron pillars of elaborate classic design By the middle of the nineteenth century, this type was being discarded for the simpler horizontal engine, and to-day the few remaining walking-beam stationary engines are regarded with a strictly antiquarian interest.



Cylinder, 81 inch diameter by 12 foot stroke Horse-power 3 800 Boiler pressure 55 pounds The two vertical pipes in front of the cylinder are the "side pipes," one the steam pipe the other the exhaust They communicate with transverse steam chests at top and bottom in which are the poppet valves. The latter are operated by two vertical rods which are lifted by cams on rock shafts, driven by the eccentrics.

ENGINE OF THE "ADIRONDACK."

In the development of the Hudson River steamboat, on the contrary the beam engine proved to be so ideally adapted to the work, that it has held its place against the multi cylinder high pressure, fast running engine, with conspicuous success In the first place, it was an easy engine to build, and, when once the foundries, machine shops, and forges had been built and a force of capable mechanics had become available, its first cost was low The engine consisted essentially of a single cylinder a walking beam a connecting rod, the A frame, which carried the main bearings of the walking beam, a jet condenser, a hot well whose piston was operated by connecting rods from the walking beam, and feed pumps operated from the same connecting rods as the hot well Judging from early prints and descriptions, the engine was quickly developed to the identical form which it carries at the present time, the principal change being the substitution, in the past quarter of a century, of surface condensers for the early jet condenser

The "Clermont," as we have shown elsewhere, transmitted the power from the cylinder to the crankshaft through a bell-crank lever Subsequently, during the succeeding two decades, use was made of a steeple engine, in which a pair of rocking beams, carried low down in the boat, were used, or the crankshaft was placed immediately below the cylinder, with connecting rods coupled from the piston crosshead to the cranks. This type, however, soon gave way to the present form with an overhead walking beam mounted on a stout timber A-frame, whose footings were bolted to the keelsons of the floor of the boat. The A frame was built of massive timbers very strongly braced and bolted, and carried at its apex the main bearings of the walking beam The guides for the crossheads were held in line by rods extending from the guides to the A-frame.

The boiler of the "Clermont" was made of copper and carried the low pressure of four or five pounds to the square inch Copper was used because iron plates were not available, but eventually, when reliable boiler plate became available iron boilers were introduced, and immediately higher steam pressures began to be used Tubular boilers were introduced in 1830 on the "Novelty," and about the year 1840 wood gave place to anthracite coal. Concurrently with the increase in boiler pressures a great advance was made in the size and power of the engines The single cylinder of the "Clermont was 24 inches diameter by 4 feet stroke The "Chancellor Livingston" of 1816 had engines 44 inches in diameter by 5 feet stroke The "Constellation ' 1825 used a cylinder 44 inches in diameter by 10 feet stroke and these remained about the maximum dimensions until the appearance of the "South America," 1840 with cylinders 54 inches in diameter by 11 feet stroke The keen contest for speed resulted in the construction of engines that were prodigious for those days and have barely been exceeded at the present time Thus in 1845 there was built for the 'Hendrick Hudson ' which was a fine vessel 320 feet long an engine with a 72 inch cylinder and 11 feet stroke, and two years later T F Secor & Co built for the 'New World" one of the fliers of that day, an engine with a 76-inch cylinder and the enormous stroke of 15 feet. Thereafter the stroke was reduced to 12 feet which was never again exceeded The largest engine afloat on the Hudson is that of the "C W Morse" of 4 000 horse-power, built in 1904 by the W & A Fletcher Company whose cylinder is 82 inches in diameter by 12 feet stroke

The permanence of the walking beam engine as the favorite drive for Hudson River steamboats, and its undoubted popularity among the directors of the companies and in the pilot house and the engine room, is largely due to the especial conditions under which the Hudson River service is operated In the first place, the upper reaches of the Hudson are very shallow during several months of the summer, and it is desirable to keep the draft of the boats as small as possible, conditions to which the broad and shallow but sweetly modeled river boats lend themselves admirably The largest vessels for the night service are of over 4 000 tons displacement, and are driven by engines of 4 000 horse-power, yet they draw only about 8 feet of water It would be a difficult proposition to drive such vessels with screw propellers. Furthermore, the large number of landings which must be made call for a boat with good manoeuvering qualities able to stop and start quickly and make quick landings at the piers. The paddle-wheel beam-engine boat has proved to be ideal for this purpose While it is well understood by the engine builders and shipping men of the Hudson River that high boiler pressures, multi-cylinder expansion, and rapidly running engines are conducive to fuel economy, it is also realized that these economies can be secured only when the engines are continuously in service Otherwise, the heavy extra capital cost of the more expensive installation is liable to exceed the saving due to coal economy The Hudson River boats are out of service for about five months of the year, and although a multi cylinder engine will run under a consumption of from 1 5 to 1 75 pounds of coal per horse-power per hour as against 2 3 pounds for a low pressure single-cylinder beam engine, the greater first cost of the plant will go far to offset the saving in the coal bill The cost of upkeep moreover of the beam engine is relatively far less The boilers built for 50 to 55 pounds pressure generally carry from 30 to 35 pounds under an easy fire. This means a lessening of boiler repairs since it is easier on steam pipes, joints and packings Moreover the engine-room force is reduced to a minimum, an engineer and an oiler generally being sufficient to take care of the average Hudson River engine

The accompanying illustrations of the 3 800-horse-power engines of the 'Adirondack" of the night line the last of the large river steamers to be built of wood will serve admirably as a reference in connection with the foregoing description of the typical river-boat engine The "Adirondack" which is 412 feet long 50 feet beam and 90 feet over the guards with four decks above the waterline, and over 400 separate berths for the passengers and crew was built in 1896 The vessel serves to show the point of size to which these stately river boats have been developed In the engraving the side of the hull and superstructure has been broken away to show the full height of the engine which was built by the W & A Fletcher Company The engine foundation consists of heavy steel keelsons The A-shaped gallows frames are built up of steel plates the legs which are of box section being strongly braced together with struts, which are also of plate steel and box section The walking beam consists of a strongly ribbed cast iron web belted with a heavy wrought iron strap the whole being firmly strapped and keyed together The cylinder is 81 inches in diameter by 12 feet stroke The two large vertical pipes seen in front of the cylinder are known as the side pipes, the one on the star

(Continued on page 229.)

THREE HUNDRED YEARS OF NEW YORK.

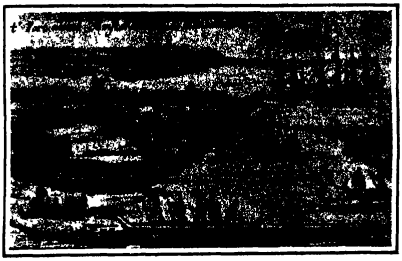
When Henry Hudson approached the opening of the upper bay he did not at first know that he was nearing the river which was afterward to bear his name He believed that it was an arm of the sea in fact that it was the northwest passage to India, that *Ignis Fatuus of so many* of the old navigators He lay in the lower bay for more than a week before he anchored in New York Harbor proper He found the neighborhood well peopled by Indians who lived in villages of fairly regular construction They were mild and inoffensive as savages go and they were quite willing to trade their tobacco and pelts for the beads and knives of the white men

Hudson at last discovered that he was at the estuary of a great river up which he sailed consuming three weeks until he reached the head of navigation at Albany Early in October Hudson turned the prow of the Half Moon homeward bringing the news of a discovery which was of the greatest possible interest among the Dutch merchants. A number of trading and exploring expeditions started out and made the trip with considerable profit to themselves

It was at last decided to establish permanent posts at the head of the river and at New York The main fort was built near the mouth of the Mohawk River and a few trading huts were built at the south end of Manhattan Island and it is from this small beginning that we are enabled to trace the industrial beginning of the city of New York

A monopoly of the fur trade was given to the New Netherlands Company which erected a trading post at New York The monopoly which was a valuable one was extended from year to year until 1621 when the Great West India Company was chartered It was under its auspices that the first real and permanent settlement in New York was made

The city of New York has been very fortunate in the preservation of the early records of its settlement The early history of Rome London and even Paris is lost in obscurity while other cities such as Berlin and St Petersburg have no history of any importance and still look painfully new and as though they were planned with the aid of the T-square and drawing pen From these records we learn that the original block house with its palisades gave way to Fort Amsterdam, around which clustered the small cabins of the first settlers Some idea of the early appearance of the settlement is obtained from a view in Hartgers "Beschrijvinghe' van Virginia," a copy of which we present herewith. This is the earliest known view of New York, and the little book in which it was published is of the greatest rarity To obtain a correct idea of the topography it is necessary to view the plan in a mirror, as it is reversed It was probably obtained with the aid of a camera obscura from some point on the Long Island shore and was never restored to its proper position. Although the print is on a small scale it gives considerable detail, the number of buildings shown being about thirty or thirty five. In the fort were situated the Governor's house, the chapel barracks for the soldiers, magazines and other necessary buildings

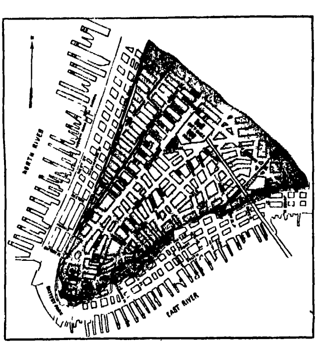


EARLIEST KNOWN PRINT OF NEW YORK CITY ENTITLED: "FORT NIEUW AMSTERDAM OP DE MANHATANS," PUBLISHED IN 1651 — POPULATION ABOUT 800

NEW YORK IN 1673

Buildings have been erected within the fortified enclosure; streets have been laid out leading to wharves. The population in [illegible] had grown to 1,500 and in [illegible] it was [illegible]

There does not appear to have been any attempt to found a substantial colony until 1621, when the Dutch West India Company came into existence. It was admirably organized and they established a strongly garrisoned colony which was the nucleus of a colonial government which was in control of a vast territory which stretched from Virginia to New England. The municipality itself, however, was of almost microscopic proportions, for in 1628 we find that the inhabitants numbered only 270, but the fort was constantly increased in strength until it became a fortress of no mean magnitude for the size of the place. In 1626, Peter Minuit purchased the whole of Manhattan Island for trinkets, the aggregate value of which was $24 It would perhaps be interesting to figure up how much the interest at 6 per cent compounded at regular intervals, would be on the $24 for the period since the purchase.

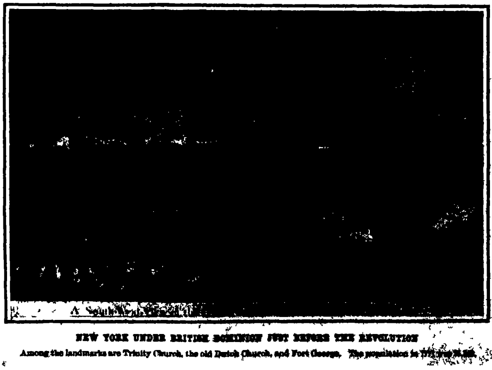


MAP SHOWING INCREASE OF CITY AREA ALONG THE WATER FRONT OF LOWER NEW YORK. THE ORIGINAL CITY IS SHADED

In 1653, when a foray of New Englanders was expected a stockade or palisade was erected across the island from east to west, thus fortifying the outskirts of the inclosure. This was at the point where we now have a teeming center of finance — Wall Street. Strange to say, this wall prevented the natural expansion of the city for over half a century and always tended to create that congestion which still remains so overwhelmingly strong Every old and important city in Europe has been cramped within a stone girdle of fortifications and long after the necessity for this has vanished the habit of congestion remains.

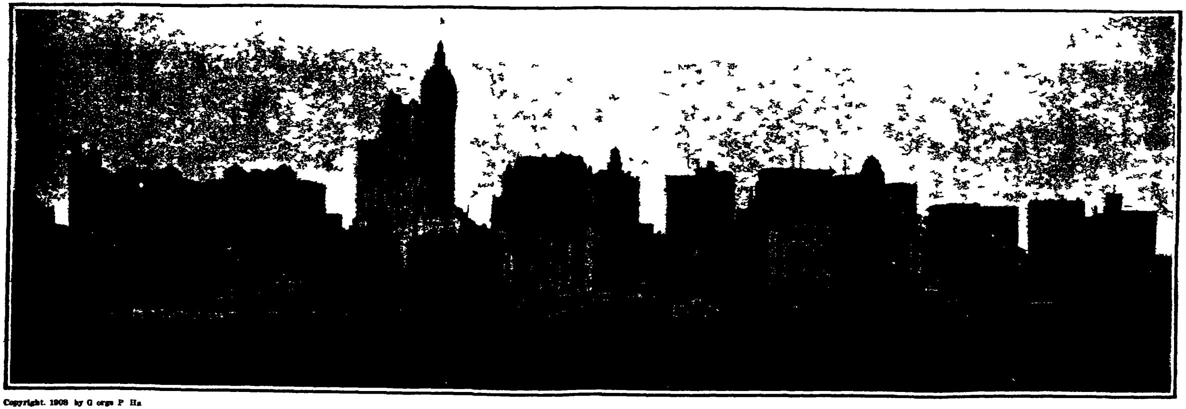
The present crowded tangle of streets at the southern termination of Manhattan Island is entirely attributable to the customs of the Dutch dwellers There was little attempt made to lay out broad or convenient streets. The foot paths and lanes became the future streets, and no better example can be adduced than this, that the early pre-arrangement of the south never obtained in northern lands. One of the earliest streets was nearly parallel with the present Pearl Street and the other with Broadway, while "Dock" Street led to the shipping quays.

After a long and rather interesting occupancy by the Dutch, the flag of Great Britain was raised on September 8, 1664, and Fort Amsterdam forthwith became Fort James. There was little or no dislike of the conquerors, who made a peaceful invasion without striking a blow England's policy was not so liberal in those days as in her present handling of colonial matters. Still, however, the Dutch hardly knew that the form of government was being changed, so that now the isolated trading post became a national colonial dependency Under the old *régime* there was no home pride among the commercial owners, but the new conditions put a different [illegible] [illegible] the [illegible]


A South West View of [illegible]

NEW YORK UNDER BRITISH DOMINION JUST BEFORE THE REVOLUTION

Among the landmarks are Trinity Church, the old Dutch Church, and Fort George. The population in [illegible]



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THREE HUNDRED YEARS LATER—THE SKYLINE OF THE HUDSON RIVER SHORE FROM CITY HALL TO THE BATTERY WITH THE SINGER BUILDING OUTSTRIPPING ALL IN HEIGHT

the inhabitants began to grow fond of their new surroundings and government.

In 1783, when New York was evacuated by the British troops, the condition of the city was most deplorable. The streets, which had been paved and partly graded before the war, had been suffered to lapse into idle wastes again. The wharves had rotted and all the public and many of the private buildings had fallen into a state of semi-ruin. The population had decreased and the city was practically wrecked. Under the inspiration of the new government the inhabitants revived the city within three years so that the former population was regained and commerce quickly returned.

We have before noted the crookedness of the streets in the lower part of the city especially below the stockade at Wall Street. At the beginning of the nineteenth century nearly all of Manhattan Island down as far as Fourteenth Street was practically a virgin territory which could be treated in any way which seemed conducive to the public good. It was thought to be wise to make a plan which would be so comprehensive that the growth of the city would be provided for for a couple of centuries or more, so that an act of the Assembly was passed on April 13, 18[illegible] and a commission of [illegible]entioned but blundering men was appointed—men who were of great importance for the time—as Commissioners of Streets and Roads [illegible] of New York. They were given much pow[illegible] a[illegible] [illegible] o[illegible] len some[illegible] on the attainments the results would have been far different. They were allowed four years in which to prepare their plans and fix posts at suitable points. In 1811 they made their reports and their maps were filed which created the city from Houston Street to Washington Heights substantially as it exists to-day. Without doubt their labors were most arduous, as a survey involving the placing of 1,549 marble monumental stones and 98 iron bolts proves. The commissioners had the opportunity to create a most beautiful city instead of the commonplace utilitarian arrangement from which the citizens are now suffering. These worthy men left undone the things which they should have done and did the things which they should not have done. They decided that the beautiful forest growths should be cut down, that the [illegible] should be leveled, streams were bridged over and filled in, and upon the plan thus produced the[y] decided that the city should be built [illegible] the aid of the T-square and triangle. As Mr. Janvier says: *The commissioners in their tol[illegible] wa[illegible] q[illegible]e[illegible]onably gave thei[r] [illegible]er b[illegible] tho[u]gh to the work confided to their indiscretion the[illegible] by their own showing [illegible] to the height of considering the [illegible]ms of what they believed to be the beautiful before they decided upon g[illegible] place to the useful alone.* I regard to parks these excellently dull gentlemen had their own views. The thought that the large arms of the sea which embraced Manhattan Island furnished all the variety required. They would [illegible] [illegible]pulate for a space to be devoted to parks although they thought that a space should be set aside sufficient for a reservoir. They also felt the need for a space for military exercises, so that the "Parade Ground," which extended from Twenty-third to Thirty-fourth Streets and from Fourth to Seventh Avenues was provided. We have the remains of the "Parade Ground" in Madison Square, and the whole space includes some of the choicest business locations in the entire city. Union Square was a union of the many roads which centered at that point for the transfer of traffic, and may be regarded as a geographical accident. They provided streets which reached as far as 155th Street northward, reaching from the Hudson to the East and Harlem Rivers. The plan of New York as we find it to-day is stupidly commonplace, and it has cost millions to give even a semblance of variety to the work of these worthy gentlemen. Among the mistakes which the commissioners made was to provide one-third less to the square mile for longitudinal streets than they did for cross streets. They did not seem to realize that they were dealing with a long and narrow island whereon the traffic would always be in a longitudinal direction, but we are now feeling the stern necessity for increased facilities for north and south travel.

In 1805 the free school system was founded. Prior to that time schooling was largely a matter of private enterprise. Each church had its own school, and there were also numerous private schools kept by teachers who were remunerated for their services. The first public school was opened in 1806. A number of scientific and literary societies were founded in New York at the beginning of the nineteenth century.

Before the days of the steamship and the railroad was the era of the fast "clipper," like those which ran from Baltimore and which were famous for their great size and speed. So fast were they that for many years after steamers were built they maintained a nearly equal fight against their more formidable rivals. Fast vessels made the trip to England in fourteen days. It seems extraordinary that the United States, that during the first half of the nineteenth century brought the art of shipbuilding to such a high plane, should be so neglectful of her ocean commerce in the last half of the century. The more recent events connected with New York city are outlined in the chronology which follows and which has been especially compiled for this issue.

When we look at the impressive [illegible]e of the sky line from the City Hall to the Battery, there is one point which is of [illegible]u[r]passing interest—how was it possible to secure enough ground to permit of the erection of such vast structures, as we know that the original territory comprised in this part of Manhattan Island in the days of Peter Minuit was not so great. When Manhattan Island was first purchased from the Indians, there was doubtless little thought that it would ever be necessary to increase the area of the seemingly large island. From the beginning, however, we find examples of made land, of docks being built of ponds being filled up, and a general tendency to increase the superficial area. In former times the island was very much narrower than at the present time although the general shape was the same The old maps show the lower part of the island extending in width barely from Broadway to the present Pearl Street

Since olden times filling has gone on along the city edge for generation after generation, until many blocks have been added, and the island has been increased by the addition of area on its outer periphery precisely in the place where the addition counts the most. Originally, the junction of Pearl Street and Maiden Lane marked the entrance of a wide canal, and another wide canal ran up Broad Street beginning at Front Street and extending nearly to Wall Street. These facts indicate the narrow limits of the old city

The rapid currents of the Hudson and East Rivers, especially the latter, had to be guarded against, and as early as 1654 it was resolved to drive planks into the shore, and to make uniform sheet piles between Broad Street and the City Hall for the lower part of the city and many other ordinances touching on the subject of the water front were passed

The map gives us a good idea of the enlargement of the city area It is only within modern times that the limit of enlargement has been fixed and bulkhead and wharfhead lines located to determine the extent to which filling and dock building operations may be carried out. The map in the shaded portions shows the original limits of the lower end of the island, while in outline are given the additions up to the present time Along the water front on this ground which has been reclaimed from the rivers are built many lofty and heavy structures which are very noticeable in our view of the skyline of New York

THE POPULATION OF NEW YORK AT VARIOUS PERIODS

1628	Under Dutch rule	270
1656	" " "	1,000
1664	British Dominion	1,500
1703	" "	4 375
1731	" "	8 622
1749	" "	13 294
1771	" "	21,863
1790	United States government	30 022
1800	" " "	60 489
1810	" " "	96,873
1820	" " "	123 706
1840	" " "	312,710
1860	" " "	805,658
1880	" " "	1,206 299
1890	" " "	1 515 301
1900	Greater New York	3,437,202
1905	" " "	4,013 781
1910	Estimated	4,810,000

EVENTS IN THE HISTORY OF NEW YORK ARRANGED CHRONOLOGICALLY

1609	The arrival of Henry Hudson on the "Half Moon"
1613	A trading-post was established on Manhattan Island by Dutch merchants.
1621	The Dutch West India Company was chartered
1626	Peter Minuit buys Manhattan Island of the Indians for $24
1635	Fort Amsterdam completed
1652	The first city charter granted
1653	A palisade was built along "Wall" Street
1656	First city survey
1658	The streets were paved with stone and guarded by watchmen
1664	The Dutch dominion surrenders to English rule.
1693	Printing press set up by William Bradford
1696	Building of first Trinity Church
1697	Streets were lighted
1699	City Hall built in Wall Street.
1707	Broadway was paved from Bowling Green to Trinity Church
1725	New York Gazette established by William Bradford
1730	Stage line to Philadelphia opened.
1731	Fire department was organized.
1763	Jersey City ferry was established
1766	St Paul's Church was built.
1774	The Hoboken ferry was established
1776	Battle of Harlem Heights Washington occupies New York
1783	Washington bids farewell to his officers.
1789	Meeting of the First Congress. New York was the federal capital Washington was inaugurated
1790	First laying of sidewalks.
1807	First voyage of the Clermont." St John's chapel built.
1811	The Commissioners of Streets and Roads in the city of New York finished laying out the present city
1812	City Hall finished
1814	Steam ferryboats were put in operation,
1817	Erie Canal was begun, and first line of packet ships established.
1819	The first ocean steamship "Savannah" was built.
1825	Gas was introduced, and Erie Canal was completed.
1833.	The New York Sun was founded.
1835	Founding of the New York Herald
1836	The Erie Railroad was begun.
1841	The New York Tribune was founded
1842.	Old Croton Aqueduct was opened.
1845	SCIENTIFIC AMERICAN was established
1846	Electric telegraph line was opened between New York and Philadelphia.
1848	Founding of Collins Line of steamships
1851	New York Times founded.
1853	World's Fair
1856	The site of Central Park purchased
1857	Cooper Institute founded
1858.	Opening of Atlantic cable
1860	New York World founded.
1862.	Building of the "Monitor"
1870	Old Brooklyn Bridge begun.
1873	The city crosses the Harlem
1877	Founding of the American Museum of Natural History
1880	Completion of elevated railway system
1883	First East River bridge opened
1898.	Greater New York created by annexation
1901.	Unveiling of the Fulton monument in Trinity churchyard
1903.	Opening of Williamsburg Bridge.
1904	Subway opened
1908.	Opening of the Brooklyn tunnel Opening of the Hudson and Manhattan Railway tunnel northern tubes.
1909	Opening of Queensborough Bridge Opening of the southern tubes, Hudson and Manhattan tunnels. Opening of the Pennsylvania tunnels. Completion of the Metropolitan Life Insurance Building Rapid approach to completion of great Pennsylvania and New York Central terminals in New York city Hudson Fulton Celebration

Aeroplane Flights During the Hudson-Fulton Celebration.

For the first time since the invention of the aeroplane New York will be given an opportunity to witness sensational flights by the leaders in aviation Those flights will be made by Wilbur H Wright and Glenn H Curtiss with their respective biplane machines Up to the time of our going to press, Mr Wright had not stated just what feats he would try to accomplish after he has made his initial flights during the present week above Governor's Island Sheds have been erected upon the island for the machines of both aviators. Mr Curtiss, who arrived from Italy last Monday after having won the Brescia Grand Prix 31-mile race in 49 minutes, 23 1/5 seconds, has signed a contract to fly up the Hudson from Governor's Island to Grant's Tomb and back, and Wilbur Wright will doubtless make fully as remarkable flights, above the waters of the lower bay In one of these Mr Wright will probably remain an hour or more in the air Mr Charles F Willard who as mentioned in our last issue, has been making flights above Lake Ontario, will perhaps make flights with the Aeronautic Society's Curtiss biplane There is also a possibility that a new monoplane, built by a member of the Society, may make flights An elaborate system of signaling has been arranged, whereby the people will be quickly notified when flights are to be made.

America Boiled Down.

In the year of our Lord nineteen hundred and nine, we find the United States the most progressive country of the world Its growth has been more than remarkable, and one who wants to boast of his country need only secure a copy of the "Statistical Abstract," a document issued each year by the Department of Commerce and Labor

This particular publication, originated some thirty years ago in the Bureau of Statistics under the direction of John Sherman, then Secretary of the Treasury, and which in its first issue was a thin pamphlet, has grown to be now an unwieldy volume crammed from cover to cover with masses of figures. At a glance such a document would seem very dry for summer reading, but after one has delved into it, the comparison in the growth or decrease of everything is fascinating

To-day the population of the United States is in round numbers 88,000,000. Last fall 14,887,133 individuals lined up at the polls to cast a vote for a Presidential nominee, And the last figures obtainable show that six thousand four hundred and sixty-six millions of letters and postal cards were sent through the mails. The table does not state whether the greater quantity of this fabulous number were post cards or not. At any rate, the quantity is two-thirds as much as the combined postal business of Great Britain, Germany, France, and Austria-Hungary, and twice as great as any one of them, notwithstanding the fact that France has the reputation of being one of the greatest letter-writing countries. The people, however, had a great many things to say quickly, and becoming fidgety over the "slowness" of the mail facilities, used slightly over one hundred million telegraph blanks, in order to relieve their nerve tension and get quick results.

Of the 88,000,000 of population, practically one-third are domiciled in the thirteen original States, another third in the States created from the territory ceded to the common union by those States, and the remaining third in the area added by purchase or annexation.

It is interesting to observe that our total continental area, including Alaska, is about equal to that of all Europe, that while the area conceded to the thirteen original States by the peace treaty of 1783 was 828,000 square miles, their present area is but 326,000 square miles, forming in part or in whole thirteen other States, while the remaining twenty-four States and Territories were created from territory added by purchase.

Uncle Sam has some resources left. There is just 754 000,000 acres of land still left in his keeping though it may be mentioned that all of it is not very desirable Almost half of this acreage is in Alaska, and much of it in the Rockies. He also has other resources besides vacant lands. In his charge there are 52,827 water wheels to be kept turning, but there is plenty of power for that purpose, for he is credited with having 5,360,000 horse-power from streams with which to keep them moving

The estimated coal supply of the country is 3,135, 708 000,000 tons, and during the last year almost a half a billion tons were mined The iron-ore supply of the United States is nearly five billions of tons, 52 000 000 tons being the amount mined for the last year reported. The wealth of the country in 1850, according to the figures available, was $7 000 000 000, speaking in round numbers, in 1890 it was $65,000,000,000, and the last figures show it to have jumped to $107,500 000,000. The last report shows that the wealth production of farms amounted to $7,412,000,000, alone more than the wealth of the country half a century ago

There has been a steady decrease in the negro population since the year 1810, the percentage in that year being 19 03 In 1850 it was 15 68 per cent of the total population, in 1860 14 12 per cent, and so on Last year the percentage was 11 59

Out of his $107,500,000,000 Uncle Sam spent during the last year just $197,000,000 for school teachers. The United States imported one and a half billions of dollars' worth of products, according to the latest figures, but half that amount was raw material for manufacturing The exports amounted to nearly two billions of dollars, about forty per cent of which represented manufactured goods.

This mass of boiled-down information presents a picture of conditions in the United States which is extremely interesting, not merely to the economist and student, but to those interested in the growth of the country

The Current Supplement.

The current SUPPLEMENT, No. 1760, opens with an excellent illustrated article on a German automobile fire engine, which has been adopted by the German city of Frankfort-on-the-Main The recent improvements in the internal-combustion engine are reviewed by H E. Wimperis. Among the economies practised in machine shops, foundries, and metal working establishments of various kinds, few are more suggestive than the use of magnetic separators. The principal applications of these as thus far developed, will be found excellently outlined in an article entitled "Magnetic Separators for Various Uses." Prof A F Ganz's admirable summary of recent electrical progress in the artificial lighting field is concluded. Efforts have been made from time to time in the past to produce the Egyptian types of cotton in America. The latest of these efforts is described by Charles Richards Dodge Ernest Rutherford's brilliant paper entitled "Visualizing the Atom" is concluded. Though Nature evidently meant the vertebrates to be a tooth-bearing race, her design has by no means been rigidly adhered to, as many creatures of very different orders have been permitted, so to speak, to adopt various substitutes therefor Mr W P Pycraft interestingly describes these various substitutes. Dr D. T Macdougal's paper on "Aridity and Evolution" is concluded.

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Prime Minister Asquith recently announced in the House of Commons that the British government would recommend a Parliament grant of $100,000 to Lieut. E. H. Shackleton, in order to defray the expense of his recent expedition. If the appropriation is made, Lieut. Shackleton will be out of debt. When he returned from his expedition, he found that he owed $315,000. With the assistance of his friends he succeeded in paying all but $70,000, which last sum he hoped to earn by writing, and by lecturing in the United States.

DEVELOPMENT OF THE HUDSON RIVER STEAMBOAT.

(Concluded from page 217.)

the development of the river steamboat had been carried at that early date. Both boats had return-flue iron boilers, and when pushed to their highest speed would burn from twenty-three to twenty-five cords of wood per trip. The rivalry between the two became so great that finally a formal race from New York to Albany was decided upon, and on November 8th, 1836, they started abreast of each other at 4 P. M. with everything tuned to the highest pitch. The "Rochester" reached Van Wies Point, 140 miles from New York, in eight hours and fifty-seven minutes, and the "Swallow" five minutes later. Some interesting details are given by David Stevenson in an English work, "Engineering in North America," published in 1838, of a trip which he made on the "Rochester" in 1837, when the distance to Albany was made in ten hours and forty minutes. The steam pressure, according to this authority, was 45 pounds, and the steam was cut off at half stroke. Speaking of the remarkable speed of American steamboats at this time he says the vessels "navigating the Hudson River and Long Island Sound perform their voyages safely and regularly at a speed which far surpasses that of any European steamer hitherto built." A good description was given during this period by a German vistor of a trip made in 1838 on the "North America." He gives the length of the vessel as 200 feet, her beam as 26 feet, and describes her as having two decks, the lower of which was about three feet above the water. There were separate cabins for men and women, that for the men being used also as the dining room. He writes: "There were 320 passengers on board, each of whom slept in a berth, and as sufficient room appeared still to remain one may imagine how colossal this floating palace must be." He paid three dollars, or two cents per mile, for the passage. In "less elegant" steamboats the fare was one dollar, and in some boats as low as fifty cents.

The inventive and original mind of Robert L. Stevens was shown in the design of the "Rainbow," an experimental vessel of very narrow beam, the breadth of which compared to her length was as 1 to 14. She was driven by a pair of inclined condensing engines, one forward and one aft of the wheel, with cylinders 36 inches by 10 feet, coupled to a common crankpin. Her boilers, strapped at every 10 inches with bar iron, 1¼ by 6 inches, carried the enormous pressure for those days of 80 to 100 pounds per square inch. The hollow wheel shaft, made of ⅝ inch boiler iron, was 3 feet in diameter. She did not make the high speed expected, and was subsequently used for towing.

The contests of speed which characterized that period were accompanied by rate wars, in which passengers were carried over the full course at rates which at one time dropped as low as twelve cents, and it is recorded that on one occasion rather than see an opposition boat carrying a full passenger list, a rival steamboat offered twelve cents apiece to the public for the privilege of taking them, the deficit being subsequently made up when the ship was under way by the simple expedient of raising the price of meals by 300 per cent.

As evidence of the high state of development to which the steamboat had been carried by the middle of the century, we quote the case of that handsome steamer "Alida," built in 1847 by William Brown of New York. This craft, of which we present an excellent illustration, was 265 feet long, 30 feet broad, and 7 feet deep. She was driven by a steam engine with cylinders 56 inches diameter by 12 feet stroke. From the very first she proved to be a "flyer"; and on May 8th she made the trip of 145 miles from Albany to New York, with six landings, in seven hours and fifty-six minutes. She

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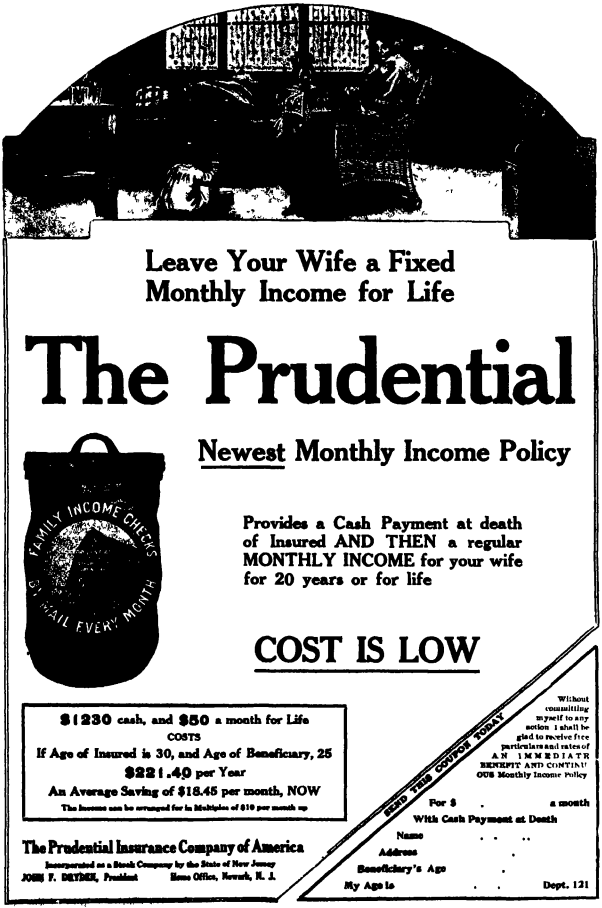
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was not however the first boat to bring the time below eight hours that distinction belonging to the South America,' which on April 19th 1843 covered the distance in the extraordinary time of seven hours and twenty-six minutes This trip however was made without any landings and the vessel was favored by a heavy freshet in the river which not only gave deep water over the shoals but set up a swift current in the vessel s favor

It is impossible within the limits of the present article to follow in detail the development of the famous steam boats on this famous river There was a steady increase in size though the speed having been carried to the high point of between twenty-one and twenty two miles an hour was destined to remain stationary We can do no more than mention two celebrated boats the 'New World of the People s Line with wheels 45 feet in diameter and a piston of 15 feet stroke and the Francis Skiddy with 40 foot wheels and a 11 foot stroke of piston two vessels which had many struggles for supremacy during the ensuing decade

We pass on to the year 1852 when in consequence of the many deplorable accidents which occurred due to the too frequent bursting of boilers Congress passed a law for the inspection of vessels which put an end to the perilous practice of steamboat racing The stories which have come down to us of the reckless way in which engineers would bottle up their boilers when racing with a rival boat are astonishing but nevertheless well verified Morrison a most careful historian credits the statement of an engineer that on being pressed by his captain to pass another boat he prepared for the contest by tying the safety valve lever drawing the pointer from the mercury gage plugging up the mouth of the tube and urging the fires under the boilers He passed the other boat but we are not surprised to learn that it was his opinion that although ordinarily he carried thirty pounds the pressure during the contest must have risen to fifty or sixty pounds to the inch

It is probable that the Hudson River boat which has attained the most world wide popularity is the Mary Powell of the Day Line which built in 1861 has been in continuous service ever since and is to-day one of the most popular boats on the river Her original dimensions were 280 feet length 34½ feet beam and 10¾ feet depth Her model is particularly sweet with a long sharp entrance and a very easy run Her fastest run was made from New York to Poughkeepsie 73¾ miles in three hours and thirty nine minutes including the time lost in six landings Deducting this time her average speed while running under full power was 22 04 miles per hour Her present captain A E Anderson a son of her previous owner and captain informs us that during her long life of nearly half a century she has been rebuilt three times and lengthened 40 feet The lines of the original boat however have been religiously preserved Her present length is 300 feet Her original engines had one cylinder 62 inches by 12 feet which was replaced by a cylinder 72 inches by 12 feet stroke in 1874 Steam is supplied by two return flue tubular boilers and she uses a working pressure of thirty five pounds under which she makes the eighteen miles per hour necessary to make her scheduled time Under the forty five pounds which she is allowed this wonderful old craft is still good for twenty miles an hour The hull of the Mary Powell was built by M S Allison of Jersey City and her present machinery by the W & A Fletcher Company of Hoboken

Another wooden vessel famous in her day was the St John 1864 the cylinder of whose engine was 85 inches in diameter with the exaggerated stroke of 15 feet.

The year 1880 was signalized by the appearance of the first iron steamboat, the "Albany," [illegible] "New York," [illegible] These, with two exceptions, are probably the fastest large passenger steamers plying on American inland waters to-day With their long, unbroken lines, graceful sheer, and triple buff-colored smokestacks, they present as beautiful a marine picture as one would wish to see Both vessels, after being some time in service, were lengthened by the addition of 30 feet, and as thus altered their dimensions are "Albany," 325 feet length by 40 feet beam, and "New York," 341 feet length by 40 feet beam the breadth of both vessels over the guards being 76 feet. The engines are of the typical walking-beam type, with cylinders 76 inches diameter by 12 feet stroke They were allowed fifty pounds pressure, but thirty-five pounds is sufficient to enable them to attain their schedule speed of about eighteen miles an hour The "Albany" holds the blue ribbon of the Hudson River On October 22nd on her way up to Albany for winter quarters, she was given an engineer's trial for speed Leaving 22nd Street at 11 01 A. M she reached Poughkeepsie dock at 2 09 P M thus covering 73¾ miles in three hours and eight minutes at a speed of 23 26 miles per hour On May 28th 1903, the sister boat, the "New York," made the same trip at an average speed of 23 21 miles per hour

In 1906 the Hudson River Day Line placed in service the handsome steel passenger steamer 'Hendrick Hudson," which measures 390 feet over all, 42 feet breadth of hull 82 feet over the guards, and draws from 7½ to 8 feet of water The vessel was designed by F E Kirby of Detroit and J W Millard of New York, who were subsequently engaged by the Hudson Fulton Commission to design the replica of the "Clermont." Including that in the hold the vessel has six decks four of which are available for passenger accommodation These decks are unusually spacious and they can accommodate without crowding five thousand passengers. The dining room has accommodations for 262 persons The vessel is driven by an inclined double-expansion paddle-wheel engine with a 45-inch high-pressure and two 70-inch low pressure cylinders acting on three cranks, the common stroke being 7 feet. Steam is furnished at 170 pounds pressure by eight boilers. The paddle wheels in this vessel as in the "New York' and "Albany," are of feathering type On her trial trip, made over the measured course on the Hudson she made 24 5 miles per hour or about one mile an hour more than the high speed credited to the "New York and "Albany" The latest addition to the Day Line boats is the 'Robert Fulton" built to replace the "New York" which was burned while in her winter quarters The 'Robert Fulton" is 348 feet in length 42 feet beam, and 76 feet in width over the guards. She was built by the New York Shipbuilding Company of Camden, N J, and was launched in the record time of two months and ten days after the keel was laid The hull, which is built of steel, is considered by the company to possess the finest model of any of the large steel vessels of the Day Line. She embodies the best features of the model of the "Mary Powell" and other fast boats, and her appearance on the year of the centennial anniversary of Fulton's great work is very timely Her maximum speed is 23½ miles an hour. Our illustrations include one of the "Adirondack," which may be taken as typical of the fine fleet of steamers owned by the People's Line which makes the night trip between New York and Albany These boats differ from the Day Line steamers in their larger size, more moderate speed, and the towering superstructure for the accommodation of the many tiers of staterooms. The "Adirondack" is 412 feet in length, 50 feet in beam, and draws 8 feet of water. Being a wooden vessel, she is strengthened by the two big suspension trusses which are such a characteristic of the American river steamboat. She has [illegible]

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The number dated October 16 and appearing on the news-stands at that time is to be a particularly good one, with unusually fine photographs There is an automobile article by Albert Lee, a story about "The Poor Man's Race Horse"—whippet hounds; an article on how to find and track deer, another concerning the use of electricity for light machinery on the farm, and still another—of rare interest—on athletics at the Vatican, with some splendid photographs.

Collier's

The National Weekly

3,800 maximum horse-power, can drive her at a speed of 30½ miles an hour. The maximum in size and accommodations is reached in the "C. W. Morse," of the People's Line, which is 427 feet over all, 90 feet over the guards, and contains 450 staterooms. The dining room will accommodate at one time 300 people. She is driven by a walking-beam engine with a cylinder 81 inches in diameter by 12 feet stroke, and her maxium speed is 20½ miles per hour.

In the above necessarily brief story of the development of the Hudson River steamboat, we have endeavored to bring out the salient points of the increase in size, speed, and accommodation of one of the most remarkable and successful types of vessel in the world to-day. It would be well in closing to refer to the phenomenal speeds which were achieved by these vessels over half a century ago and draw attention to the fact that their record passages were usually made when wind and tide were favorable. The swiftest of the present-day boats would undoubtedly exceed the earlier speeds though by no very great margin, and it must be remembered that under existing conditions, they are run under a fixed schedule, generally under a reduced steam pressure and are operated at several miles less speed than the maximum of which they are capable.

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THE AMERICAN WALKING-BEAM ENGINE

(Concluded from page 223.)

board side being the steam pipe and the other the exhaust. Each of these pipes carries a separate rocking shaft, which is operated by its own eccentric. The motion of each rocking shaft is communicated to two vertical lifting rods, which operate the valves by means of two cams called "wipers." The eccentric rods are formed with hooks at their outer ends which engage a pin in the arms of the rocking shafts. They are thrown out of gear by means of the slotted vertical rods through which the eccentric rods work, one of which will be seen in the engraving. These vertical rods are known as strippers and they are operated by the levers which will be noticed attached to the rocking shaft on the steam pipe. When it is desired to start or reverse the engine, the eccentrics are thrown out of gear, and the valves are worked by a steam starting and reversing engine which is controlled by the vertical lever seen near the steam pipe. If it is desired, the valves can be operated by the vertical starting bar shown in the engraving.

The handwheel on the small vertical standard in front of the exhaust pipe opens the steam valve for the starting engine, and the wheels which are seen on the other two standards are for operating the injection valve and for turning the surface condenser into a jet condenser, if at any time it should be desired to do so. The surface condenser is located in front of the steam cylinder and below the main deck. Behind the steam cylinder and also below the main deck is the air pump which is operated by connecting rods from the walking beam. The gear shown attached to the front face of the gallows frame above the cylinder, is a hand winch for lifting the cylinder head.

The paddle wheels are of what is known as the vertical or feathering type, in which the buckets are made to enter and leave the water in a nearly perpendicular position. The old type, with fixed radial buckets, is extravagant and uncomfortable, extravagant because it wastes power in forcing water downward when the buckets strike, and lifting it when they leave the water, and uncomfortable because it sets up a violent vibration throughout the whole vessel. The feathering paddle wheel is smoother and more efficient in its action, and its efficiency is from 12 to 15 per cent greater than the older type. Its construction is as follows: Bolted to heavy timbers just above the guards is a large pin carrying a loose flanged ring to which are pivotally attached a set of connecting rods. At their outer ends these rods are pivotally connected to rocking arms fastened to the back of the buckets, the buckets themselves being pivotally attached to the rigid spokes of the paddle wheel. The pin and loose ring are placed eccentrically to the crankshaft, and the ring is rotated in its proper relation to the paddle wheel by attaching one of the connecting rods rigidly to it. The eccentricity of the ring is so adjusted that the buckets shall always enter and leave the water in a perpendicular position, thus securing a true feathering action. The wheels are 30 feet in diameter.

Steam is supplied by four steam boilers of the lobster return flue type, each 11 feet wide, 9 feet 3 inches diameter of shell and 31 feet long, with steam domes 87 inches diameter and 10 feet 6 inches high. Forced draft is supplied by two large Dimpfel blowers driven by independent engines. The steam pressure is 55 pounds to the square inch and the total horse-power is 3,800.

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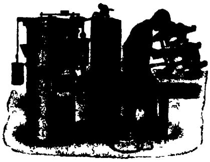

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RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

ADJUSTABLE PATTERN.—M. [illegible], New York, N. Y. This invention consists in the construction and combination of parts, whereby the different edges of the pattern may be moved outwardly or inwardly substantially in parallelism without varying the relative proportions or the general shape of the pattern. Attachments are employed for varying the style of the garment, rendering one pattern useful for cutting different forms of garments.

PNEUMATIC HEEL CUSHION.—W. J. Connors, Deal, N. J. The cushion is such as worn at the heel of the shoe on the inside in order to cushion the heel in walking. The cushion has an improved form which increases its elasticity in action, and a further object is to provide improved means for holding the cushion in position.

Electrical Devices.

TELPHER SYSTEM.—B. T. [illegible], Allen, Md. In this case the invention relates to telpher systems and is particularly applicable to rural mail delivering routes in which the delivery points are relatively far apart. It may be used also as a parcel delivering system or for any purpose in which the rapid transportation of slight matter is desirable.

HEADGEAR FOR SUPPORTING LIGHTS.—D. F. [illegible], Willimantic, Conn. The gear is for use by surgeons, dentists and opticians and supports an electric light and delivers the rays directly upon the object under inspection. The main feature involves a spring metal band adapted to extend over the head from the front to the back and be retained in position by resilient engagement with the forehead and back of the head.

Of Interest to Farmers.

BEEHIVE.—J. Weaver, Fort Worth, Texas. The object among others here is to provide a hive of concrete or cement whose walls will be thick enough to exclude heat and cold and whose interior will be large enough to receive any desired form of honey frames and which will afford at its entrance ventilating means, cleaning out means and means for the passage of the bees into and out of the hive.

PEA HULLER.—W. L. Hay, Franklin, Tenn. The intention of this inventor is to provide a device of comparatively simple construction in which the hulling of picked peas or of peas on the vines may be accomplished by merely shifting the concave and feeding the peas through the device in the direction most suitable for their proper treatment.

DEVICE FOR TEACHING MILKING.—P. J. DeVries, Hull, Iowa. The purpose of the improvement is to provide a device that simulates the udder and teats of a cow pendent therefrom, together with other details that afford means for practising the removal of water from the artificial udder by a proper compression of the teats and thus acquire the art of milking quickly and safely.

Of General Interest.

SOLDER FOR ALUMINIUM.—J. L. [illegible], 22 Rue de Bagnolet, Paris, France. This solder is not easily broken and it readily resists the action of acid and water. It may be used for soldering pieces of pure aluminium or of the alloys thereof, or for soldering aluminium upon copper, zinc, steel and other metals, regardless of the general shape and thickness of the parts.

BUTTER AND LARD CUTTER.—C. H. Carlson, Iron Mountain, Mich. The invention is an improvement in self measuring lard and butter scoops for use in taking lard or butter out of barrels, tubs, or other receptacles. The blades may be made of different sizes to measure different quantities of the material.

and the blades or other portions of the device may be of any suitable metal or material.

DISPLAY STAND.—I. Towle, Oremont, Ga. The invention pertains to stands for postal cards and similar articles and more particularly to one having a number of leaves or partitions movably supported upon a suitable standard and having the surfaces perforated to permit clips for holding the cards or other articles to be inserted at a number of points and in different positions.

METHOD FOR PROTECTING GROWING PLANTS AND VEGETABLES.—E. R. Drake, De Land, Fla. In this case the improved method of growing plants consists first in protecting the plant bed on its several sides but leaving the same open and spaced above; next, when the plants have grown to a considerable height raising the protecting parts correspondingly and also shading the plants along the sides and overhead.

Railways and Their Accessories.

SEAL.—R. A. Finian, Iola, Kan. The device is especially intended for sealing railway cars and the like, and the initials of the railroad or the firm using the seal may be embossed on the annular space between the dished portion and the periphery of the disks. The leaden seal may be impressed with the station number or other suitable designation showing where the seal is placed.

RAILWAY TIE AND RAIL CLAMP.—W. C. Neel, Lakin, Kan. The aim of the invention is to produce a tie having an improved form and particularly adapted to be constructed of metal. A further object is to produce a clamp to be used in connection with a metal tie and which will operate effectively to hold the rail in position without the use of spikes or similar fastening devices.

CAR DOOR OPERATOR.—F. F. Unckrich and C. I. Seaker, Galion, Ohio. The invention relates more particularly to a car having a plurality of doors, a controlling member, operable from various points of the car for simultaneously opening and closing the doors and connections between the members and the doors, parts of the connections being adapted to be inoperably disposed so that the controlling member can be rendered inoperative with respect to any one of the doors.

Pertaining to Recreation.

PUZZLE.—R. D. Clover, Weston, Colo. The present object is to provide a puzzle with an outer run way and inner run way surrounding goals, with gates in the run ways and goals so disposed that considerable skill is required to roll balls from the run ways through the gates and goals [illegible] respective goals.

GAME APPARATUS.—W. H. [illegible], Mornington, Victoria, Australia. The invention consists in the construction and arrangement of parts constituting a game apparatus. A board or table is provided upon which are placed miniature forts, men, castles, and numerous objects. Toy shooters are provided fitted with spring mechanism adapted to project balls, shots, or pellets through ports from the four corners of the board against the forts, men, and flags.

Pertaining to Vehicles.

DETACHABLE RIM FOR PNEUMATIC OR OTHER TIRES.—M. A. Lambercier, 112 Rue de Richelieu, Paris, France. In this patent the invention has reference to a detachable rim which allows a complete pneumatic tire fully inflated, or a solid India rubber tire, mounted on said detachable rim to be attached to or detached from the wheel of a vehicle with great rapidity.

CASING FOR PNEUMATIC TIRES.—J. H. Seiberling, Jonesboro, Ind. The casing is arranged to permit its convenient or ready application on either single clench or double clench style of wooden rim, it being provided for this purpose with separable abutting edges and single exterior locking ribs arranged at equal distances from the edges, the portion of the casing extending from the base of each rib to the corresponding edge gradually diminishing in thickness and forming a pliable non-clenching closing flange.

VEHICLE-WHEEL.—W. L. Howard, Trenton, N. J. The invention relates more particularly to the mechanism for rigidly locking the rim in place yet permitting of its ready removal. It is particularly adapted for vehicle wheels having pneumatic tires carried by the rims, the object being to facilitate the removal of the rim and tire and the substitution of a new rim and tire in case of puncture or other injury.

SPEED-GAGE.—O. D. Munn and J. K. Brachvogel, New York, N. Y. The invention is particularly useful in connection with devices intended for measuring the speed of railroad trains, automobiles, and the like. An object is to provide a gage by means of which the speed of moving bodies can be measured with accuracy and which is insensitive to shocks and concussions. A circulating fluid medium is employed which is sensitive to extremely slight changes in the degree of velocity of the moving body.

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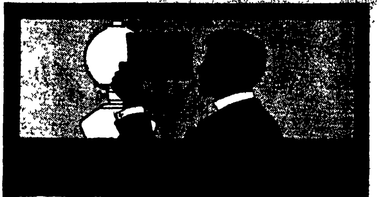

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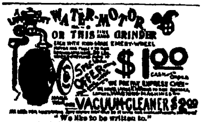

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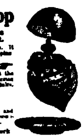

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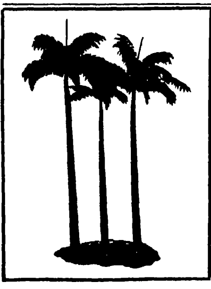

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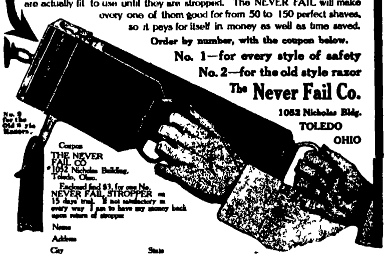

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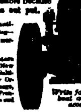

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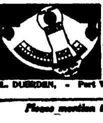

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Elevator B M Walpole	[illegible]
End gate fastener W W Meyer	[illegible]
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Engine ignition device gas A J Gifford et al	[illegible]
Engine plant heat S. Lake	[illegible]
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Excavator, R. E. Watson	[illegible]
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Explosive Clement & Langhard	[illegible]
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Eyeleting machine W F Lautenschlager	[illegible]
Fabric See Knitted fabric	
Fabrics, machine for cutting friction L. Atwood	[illegible]
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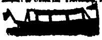

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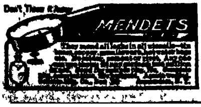

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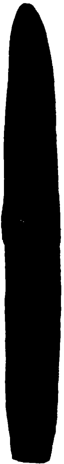

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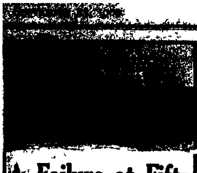

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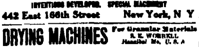

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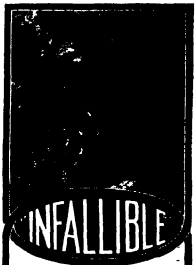

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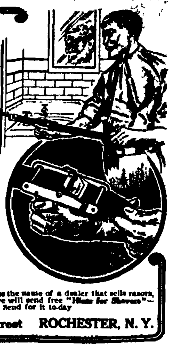

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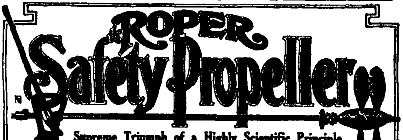

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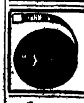

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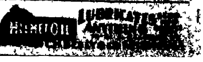

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SCIENTIFIC AMERICAN

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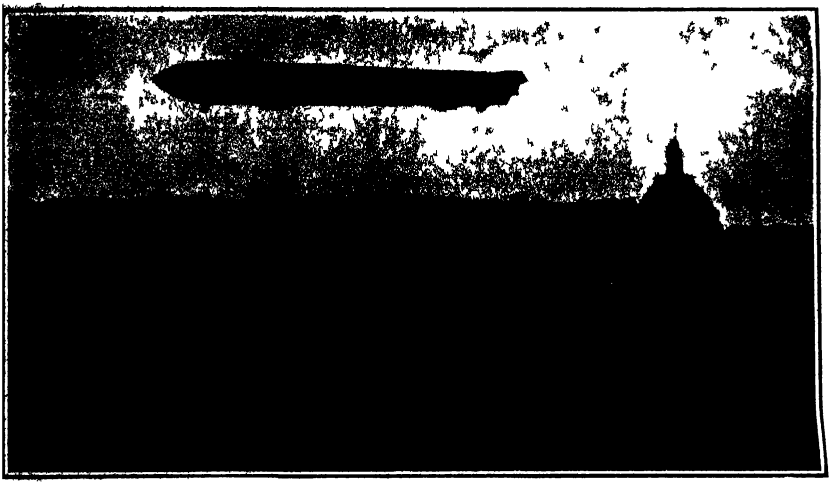

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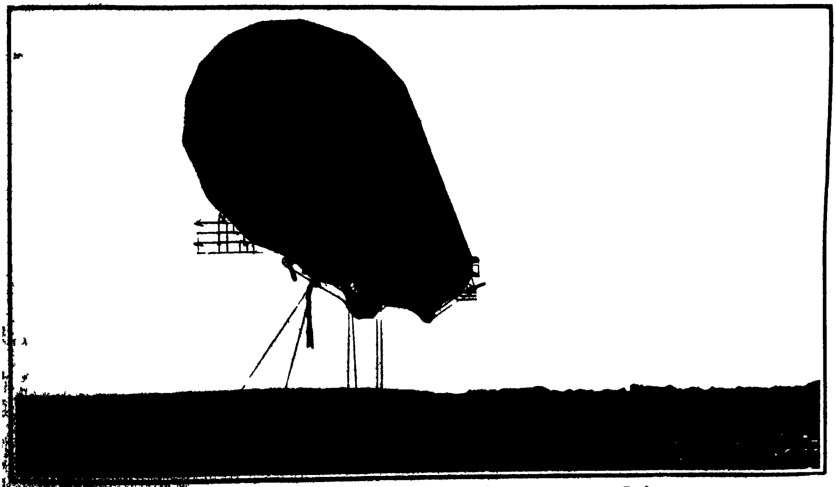

Front view of the Zeppelin airship showing it about to land at the parade ground at Tegel.

THE FRIEDRICHSHAFEN-BERLIN FLIGHT OF THE "ZEPPELIN III."—[See page 242.]

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ESTABLISHED 1845

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NEW YORK, SATURDAY, OCTOBER 2nd 1909

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

TRUE SIGNIFICANCE OF THE HUDSON-FULTON FESTIVAL.

The splendor of the Hudson Fulton festival stands for greater things than the mere exploitation of two individual men. Back of the music and the shouting the blaze of color, the roar of saluting guns, and the blended laudation of press pulpit and platform—back, indeed, of the two men whose names are in every mouth and before every eye are two cardinal facts of world wide and age-long import and endurance, to which we must look for an explanation of the stupendous scale of this festival and the universal interest which it has awakened.

Why do we give Henry Hudson such pre-eminence over Gomez and Verazzano and place Fulton above Fitch, Symington, and Stevens?

The transcendent importance of Hudson's voyage to New York Bay and up the river which bears his name is due to the fact that he explored and opened up to the world the great highway of travel which nature had laid down from the Atlantic seaboard to the heart of the American continent. Gomez and Verazzano dropped into New York Bay as they did into many another inlet, and probably gave it value as one of several convenient watering places encountered on their coastal voyage.

Although Verazzano made mention of a great river it is evident that he made no exploration to ascertain whether it was a river or an arm of the bay. Indeed, the fact that it was saline and tidal must rather have suggested a closed arm of the sea than a noble fresh water river. Henry Hudson on the other hand, not only sailed through the river for its whole navigable length but he noted its flora and fauna the appearance and habits of life of the inhabitants and everywhere appears to have made free use of the sounding lead not only throughout the river but in his exploration of New York Bay.

And just here we venture the suggestion that, when so astute a man as Hudson had reached the head of navigation he probably made such investigation as sign language and other means of intercourse with the Indians allowed of the nature of the country which lay beyond. It is not unlikely that from the Indians he learned of the extensive Mohawk Valley beyond the Hudson of the chain of lakes to the north and of the westward route through which by canoe and portage the travel and traffic of the Indian tribes were maintained from the Atlantic Ocean to the inland seas of fresh water that we now know as the Great Lakes.

Bitter indeed must have been Hudson's disappointment when the shoaling of the water just beyond Albany proved to him that his hope of finding a northwestern strait leading to the Pacific was merely a dream, but his regret was mitigated to no little degree if he realized that he had found a great natural highway into a vast continent of whose extent the Indians probably were able to give him a not unworthy estimate.

But setting all mere conjecture aside it is certain that Hudson's careful and intelligent exploration of the Hudson River as distinguished from the cursory and unappreciative glimpses obtained by Verazzano, and possibly by Gomez produced immediate results among the enterprising Dutch traders, and led to the early founding of a city and colony destined to become the most famous and powerful on the whole of the new continent. To the *veni vidi* of Gomez and Verazzano, Hudson added the *vici* of one of the most successful and, in its effects, momentous voyages of exploration that the world has ever known. Right worthily does Henry Hudson bear his honors.

The work of Robert Fulton, two hundred years later, was the natural complement of that of Henry Hudson. Because of the inadequate means of transportation the new colony was unable, for fully two centuries, to reap the full fruits of Hudson's discovery of this great highway to the West. It is difficult for us to realize the crude condition of travel prior to 1807. There were but few really good roads, the majority were not much better than cleared tracks through the primeval wilderness. Travel by road was laboriously slow, and sailing up or down the Hudson in the cumbersome sloops of those days was little if any, better. But the beat of the paddle wheels of the 'Clermont' ushered in an entirely new method of transportation, which was destined to do more for the development of the country in a few decades than had been achieved in the two centuries preceding. The success of the steamboat was one of the causes which led to the construction of the Erie Canal. The rapid opening up of the country which followed upon the superior means of transportation thus afforded was exceeded only by that even more swift and complete settlement and exploitation, which followed on the institution of steam railroad travel. This in turn followed the same great highway through the Hudson and Mohawk valleys to the Great Lakes and the far West.

Hudson in 1609, and Fulton two centuries later, may have had some glimpses of the ultimate outcome of their respective achievements, but in their wildest flights of imagination did they dream that a thousand ships would join with a city of 4,500 000 souls to grace the scene of their early labors, and render them the present stupendous tribute?

ONE HUNDRED YEARS OF THE MARINE ENGINE.

Reminiscence and comparison will be rife during the week of the Hudson Fulton Celebration, and never will they be more active, surely, than when that curious marine craft, the 'Clermont," slowly creeps under the impulse of her antique engine over the waters of New York Bay and the Hudson River.

In the 'Clermont' engine, as in all the Watt engines of that day the low steam pressure of four or five pounds above the atmosphere, was made necessary by the weakness of the copper boilers. The pressure being low the condenser was, necessarily, of vital importance, yet the vacuum could scarcely be called satisfactory, for during the trial trip of the replica of the Clermont,' we noticed that the vacuum stood at about 22½ inches. Wood was used for fuel, and probably the consumption per horse power per hour was equivalent to not less than five or six pounds of coal.

The marine boiler and engine are greatly indebted to the activity of the Hudson River steamship builders for their early improvement. We know that compound engines were used on this river as early as 1824 and that they showed satisfactory results. Furthermore steam pressures of as high as 50 pounds to the square inch were used on the Hudson River long before the middle of the last century.

The marine engine made slower progress in ocean navigation than on the rivers, and particularly on the Hudson. The earliest transatlantic steamers say of the period from 1845 to 1855, used boiler pressures of from 10 to 20 pounds to the square inch, and the approximate consumption of fuel was from 4½ to 3½ pounds per horse-power per hour. From 1855 to 1865 when the paddle wheel gave place to the screw propeller the approximate boiler pressures were from 20 to 35 pounds and the consumption of fuel was reduced from 3½ to 3 pounds per horse-power per hour. In the ten years, from 1865 to 1875, of the development of the transatlantic marine engine, the compound took the place of the simple engine, and steam pressures rose from 35 to 60 pounds, while fuel consumption was reduced from 3 pounds to 2.2 pounds per horse-power per hour. With the introduction of triple-expansion engines during the period from 1875 to 1885 the boiler pressures were doubled from 60 pounds to 125 pounds, and the approximate consumption was reduced from 2.2 to 1.9 pounds per horse-power hour. Then, in that notable period from 1885 to 1895, came the twin-screw quadruple-expansion engine, with boilers using forced draft and carrying pressures of from 125 to 225 pounds per square inch. The resultant economies were remarkable, the fuel consumption per horse-power per hour falling from 1.9 to 1.4 pounds per horse-power per hour.

Then came the most radical improvement in the marine engine in all the hundred years since the days of Fulton, when Parsons introduced the steam turbine, whose advantages ultimately proved to lie not so much in a further reduction of fuel economy, as in economies of weight, engine room space, consumption of oil, the great reduction of the cost of repairs and general up-keep, and above all in a great increasing of speed. Strange to say, boiler pressures, which had been mounting steadily upward, fell from the maximum of 225 pounds, as used with multiple-expansion engines, to about 150 or [illegible] pounds, which was found to be the most economical pressure for a turbine. The fuel consumption in high-speed turbine vessels is approximately the same as that of the very best reciprocating engines using all the modern contrivances of forced draft, superheaters, etc. Such are the conditions which obtained during the period from 1895 to 1905.

The present decade is being devoted to the development of the marine turbine, by the removal of certain defects, which at present seriously limit its usefulness. As matters now stand, the turbine drive gives its best results only when applied to comparatively high speed vessels, and when they are driven at their maximum power. As the speed decreases, there is a loss of efficiency. Furthermore, the economical speed for the propeller is an uneconomical speed for the turbine. The present development is in the direction of combining the reciprocating engine with the turbine, using the former for the higher ranges of expansion and the turbine for the lower ranges. This combination gives an engine which can run economically at a low or cruising speed, that can reverse, and that can show as good economy on a cargo steamer as an all-turbine engine on a high-speed vessel.

Figures have recently become available of the first ocean-going installation of this kind, which was placed in the cargo steamship 'Otaki." Since her delivery in November, 1908, this ship has completed a voyage to New Zealand and back. She is a sister ship, except in her engines, to two other vessels, the 'Orari" and Opawa," fitted with reciprocating engines. The "Otaki" is driven by two sets of triple-expansion reciprocating engines, one on each wing propeller, and a low-pressure turbine driving a center propeller.

A comparison of the relative performance of the two ships shows that at the full-speed trial the "Otaki" developed 5,880 horse-power, as against 5,350 horse-power shown by the "Orari'. Her coal consumption between Liverpool and Teneriffe was 11 per cent less when steaming under similar conditions and at practically the same speed. A comparison of the coal consumption for the whole of the voyage shows a gain for the 'Otaki' of 8 per cent, or 500 tons of coal. The engines made a non-stop run from Teneriffe to New Zealand of 11,669 miles. The coal consumption, on the run from the Clyde to Liverpool at about half the power, worked out at 1 387 pounds per horse-power for all purposes—a most satisfactory result.

In the steam turbine we have apparently reached the limit of efficiency in the history of the steam marine engine. The indications are that the developments of the future will be in the direction of an internal-combustion engine using either oil or producer gas.

COMBATING INJURIOUS INSECTS WITH THE AID OF THEIR NATURAL ENEMIES.

An interesting instance of successful warfare waged against injurious insects with the aid of their natural enemies is reported from Hawaii where the sugar plantations have in recent years been threatened with annihilation by the ravages of a small cicada little more than ⅛ inch long. Prof Kirkaldy, the director of the Honolulu entomological station has described the little insect and named it *Parkinsiella saccharicida*. It pierces the stem of the sugar cane and extracts the sap, causing the plant to wither and die. The formidable character of this insect pest is due to the amazing rapidity with which it multiplies. Six generations are produced annually and on the assumption that 20 females of each brood live to reproduce their kind, it is estimated that the progeny of one female produced in the course of a single year, numbers 64 millions. The insect was undoubtedly introduced with the sugar cane from other countries into Hawaii, where it has multiplied enormously, as its natural enemies which limit its numbers elsewhere, do not appear to have been imported with it. Entomologists were, therefore, sent abroad to discover the original home of the little cicada, to find its natural enemies, and to bring these to Hawaii. It was necessary to extend these laborious and costly investigations to every part of the world from which sugar cane plants had been imported. The home of the insect was finally located in Australia, where two of its most formidable enemies were also found. These are two species of ichneumon fly, of the genera *Paranagrus* and *Ootetrastichus*, which lay their eggs in the eggs of the cicada. The first-named species destroys only the cicada eggs in which its own eggs are deposited, but the other species pierces only one egg of each cluster of cicada eggs and its larva destroys the entire cluster. Both species have been successfully colonized in Hawaii and the prodigious increase of the sugar cane cicada has thus been checked.

* * *

The first steel steamship ever built in the maritime provinces of Canada is under construction at Yarmouth, Nova Scotia. A great development is expected in this industry, which, in the days of wooden vessels, was such an important factor in the prosperity of the provinces bordering on the Atlantic coast.

ENGINEERING.

The Canadian government has decided to advise the board of engineers to call for tenders for the new Quebec bridge, to take the place of the ill-fated one which collapsed during construction. The span has been reduced from 1,800 to 1,718 feet, and plans are to be prepared for bridges of both cantilever and suspension type, the style adopted depending upon cost and speed of erection and general usefulness as compared with expenditure.

Two suction dredgers built by Messrs. William Simons & Co for use in reclamation work by the Bombay Port Trust, which will add a square mile of land to Bombay, have given remarkable results in their acceptance trials. They are equipped with powerful spiral cutters at the end of their suction pipes, and eat their way into solid blue clay at the rate of 2,700 cubic yards an hour, discharging it 4,500 feet away through a pipe line half of which is floating One of them has made a cut 300 feet wide at the bottom, 21 feet deep, and 1,000 feet long in 85 actual dredging hours.

Bids have been opened on the U S battleships "Arkansas" and 'Wyoming" and announcement of the letting of the contracts is expected These will be the largest battleships in the world, the plans calling for 26,000 tons displacement 545 feet over-all length 93 feet beam 29 feet draft, and 33 000 horse-power engines, giving a speed of 21 knots. Since the British "Dreadnought" set the fashion in all-big-gun battleships, the size and gun capacity of each new ship of the U S. navy have been steadily increased, but these will be the first two ships to exceed all records of foreign navies The Cramps made the lowest bid of $4 450 000

The steamship 'Otaki," built by Messrs. Denny of Dumbarton, is the first merchant vessel to be fitted with "combination" engines consisting of two sets of triple-expansion reciprocating engines driving wing propellers and a low pressure turbine driven by their exhaust steam driving a central propeller The act of reversing the reciprocating engines closes their connections with the turbine, which is not reversible, and diverts their exhaust to the condenser Otherwise the "Otaki" is identical with the sister ships 'Orari' and "Opawa" of the same company, fitted with reciprocating engines. On a recent round trip to New Zealand the 'Otaki" made the same average speed as her sister vessels with a coal consumption of 11 per cent less than their mean, and a water consumption nearly 20 per cent less, their boilers being identical with hers. She also made a non-stop run of 11 669 miles probably the longest continuous run yet made by a marine turbine.

Some interesting tests of timber under long-continued loads by Mr H D Tiemann of the Yale Forest School were described by him in a paper read before the American Society for Testing Materials The test specimens were continuously loaded in some cases for a year or more, and their deflections under load recovery under partial release of load and other behavior automatically recorded As in the case of ductile metals a curious effect due to plasticity is noticed, which while allowing the timber to be distorted and even to take a set does not affect its ultimate strength The deflections or recoveries due to immediate addition or removal of loads are independent of the deflections or recoveries due to time effect of dead loads. A remarkable relation between the moisture absorbed and the strength of the beam was also shown increase of moisture in the atmosphere causing the test specimens to increase in deflection and decrease in strength to the point of failure

Engineering and building construction for earthquake countries is discussed in an interesting and authoritative manner by Prof. W H Hobbs in the current Engineering Magazine The article summarizes the results of a number of investigations resulting from the California, Italian Japanese, and other earthquakes, showing the lessons learned from practice in localities especially subject to earthquakes as well as from laboratory experiments with materials. It has especial interest in reference to the suggested liability to damage by earthquake of the Gatun dam and locks at Panama. Whereas it is shown that alluvial filled and other unconsolidated formations, especially when marshy afford more dangerous building sites than solid rock near the surface on account of the tendency of the latter to dissipate a shock, it appears that considerable displacement of underlying rock will hardly appear at the surface of overlying loose material if the latter is sufficiently deep. It is further shown that on such loose material rigid buildings, especially when supported upon massive monolithic foundations, are less liable to damage than more elastic structures. It would therefore appear that the deep alluvial deposit in the old river bed under the Gatun dam, much talked of as a danger spot in the construction, represents as safe a foundation as possible in an earthquake country for the massive monolithic structure of the locks and dam.

AERONAUTICS.

On September 21st, Hubert Latham attempted a flight with his 'Antoinette monoplane at Berlin One wing touched the ground twice with considerable shock; then a wheel collapsed and the propeller was broken After repairs had been effected, however, he succeeded, on September 24th in making a splendid flight of 1 hour and 8 minutes' duration

In addition to the World's $10 000 prize for the quickest flight by an aeroplane or dirigible from New York to Albany, the American has offered a prize of $1,000 for a circuit of Manhattan Island by an aeroplane. Three airships are ready to start in the first mentioned contest, these being the dirigibles of Capt. Baldwin John Roeder and George L Tomlinson The start will be made from 119th Street and the Hudson River

The flights of Wilbur Wright and Glenn H Curtiss above New York Bay and the Hudson River during the present week are to be the leading feature of the Hudson Fulton Celebration The flights will be announced by flag signals displayed from the Singer and Metropolitan towers, and by bombs, as follows White flag with red center—weather favorable flight will probably take place in the afternoon Black flag with white center—weather unfavorable, no flight to-day White flag with red center over red flag with white center—flight will probably take place within the hour Red flag with white center over white flag with red center—flight will take place within 15 minutes The same with black flag with white center below both—flight has started

At Morris Park late in the afternoon of September 23rd, Charles Crout made a short flight of 60 feet at an elevation of about eight feet with a new biplane built by François Raiche a member of the Aeronautic Society This is the first aeroplane built by a member to succeed in getting off the ground It was run along the track at a speed of 15 to 18 miles an hour against a 12 to 15-mile wind when the flight was accomplished The balancing planes were not operative and the aeroplane tipped in alighting and damaged one end of the lower plane Exhibition flights will be made soon with this machine throughout the country The aeroplane has been acquired by the Scientific Aeroplane and Airship Company which will conduct the exhibitions with it and also with several monoplanes which the company has produced

In the course of his exhibition flights recently at Berlin, Orville Wright made several new records On September 18th, with Capt. Englehardt as passenger he flew 1 hour 35 minutes and 47 seconds thus beating by 23 minutes and 11 seconds his previous record with a passenger During this flight he sent his machine beyond the limits of the Tempelhof parade ground and soared over the railroad tracks and houses in the vicinity In a subsequent attempt during the same day to beat the speed record, the water circulation of the motor gave out, and he was obliged to descend after a flight of 1 hour and 24 minutes. A few days before Orville Wright flew at an estimated height of 50 meters above a balloon anchored at a height of 175 meters thus making the altitude he reached probably over 750 feet Rougier on the 20th ultimo attempted to break this record at Brescia Italy with his Voisin biplane He succeeded in making an official record of over 198 meters (650 feet) Mr Wright will probably fly at the aviation meeting at Berlin during the present week after which he will go to England, in order to test the first Wright aeroplanes built there for the British government

The day following his arrival from Europe, Glenn H Curtiss, the winner of the Bennett aviation trophy and the present holder of the SCIENTIFIC AMERICAN Trophy as well, was given a luncheon at the Lawyers' Club by the Aero Club of America Among the distinguished guests present were William Marconi, the inventor of wireless telegraphy and St Clair McKelway editor of the Brooklyn Eagle The latter told of a trip to Goshen N Y back in 1867 in Andrew's dirigible, an account of which was subsequently published in the SCIENTIFIC AMERICAN This airship (which was made to travel in any desired direction by means of long inclined planes between the triple, parallel cigar-shaped gas bags the planes causing the balloon as it rose from the buoyancy of the gas, to ascend upon a long incline) on this occasion traveled as far as Goshen N Y (50 miles) whence it was blown back by the wind across Long Island Sound to the eastern end of Long Island where a successful landing was accomplished In view of his exploit 42 years ago in this, the first dirigible balloon Mr McKelway believed himself to be the oldest aeronaut present. The mayor of Baltimore, Md read a telegram announcing the flight of Lincoln Beachy from that city to a point in the Blue Ridge Mountains, 125 miles away—a flight which is probably the longest ever made in America with a dirigible balloon The aeroplane with which Mr Curtiss won the Bennett trophy will be exhibited at Wanamaker's store in New York this and the coming week.

SCIENCE.

The record of altitude in aeronautics has been attained by Sig. Placenza and Lieut. Mina, in an ascension made from Milan on August 10th, 1909 Their great spherical balloon the 'Albatross," carried 2,600 pounds of ballast at the start and reached an elevation of 38,700 feet or more than 7 miles. The aeronauts experienced a temperature of —25 6 deg F and landed near Milan 3½ hours after they started

The great tidal waves observed at Marseilles on June 15th, 1909, appear to have been caused by the unusually high electric charge of the atmosphere which is known to have existed during the period of the earthquakes which devastated the south of France The powerful attraction exerted on the surface of the earth by this electric charge caused earthquakes on land and tidal waves in the Mediterranean

Prof. Percival Lowell has noted at his Flagstaff Observatory that the antarctic canals of Mars are disappearing This waning of the much-discussed canals seems to be a well recognized phenomenon Long ago Prof Pickering suggested that we see not really the canals but rather the vegetation which fringes their banks The waxing of the canals in spring and summer and their waning in autumn and winter is not unreasonably attributed to the growth and decay of this vegetation

In accordance with the resolutions of the last International Congress of Mining and Metallurgy Applied Mechanics and Practical Geology held at Liége in 1905 it has been arranged that the next Congress shall meet at Düsseldorf during the last week of June 1910 under the auspices of the Rhenish Westphalian Mining Industry An influential committee of organization has been formed which is charged with the making of the arrangements for the reading and discussion of papers, visits to places of technical interest and social entertainments

A letter has been received at Harvard Observatory from Prof E B Frost director of the Yerkes Observatory stating that Halley s comet was observed visually by Prof S W Burnham with the 40-inch telescope, on September 15th 21 h 39 m G M T in app R A 6 h 18 m 51 1 s and app Dec +17 deg 9 min 44 sec The comet followed B D +17 deg 1232 by 12 7 min, north 4 min 12 1 sec The comet was also photographed with the 2 foot reflector on September 15th and 16th by Mr Oliver J Lee A second letter received at this observatory from Prof Frost states that the comet was also observed visually by Prof E E Barnard on September 17 d 21 h 1 m 30 s G M T in app R A 6 h 19 m 0 9 s and app Dec +17 deg 9 min 0 8 sec The comet followed A G 2122 (=+17 deg 1232) by 0 min 22 55 s. north 3 min 28 9 s Description 15½ mag 12 s diameter with possibly a faint nucleus or indefinite fleck of light in it The comet was also photographed by Mr Lee at the same time

The astronomers of Lick Observatory have been making some spectroscopic studies of Mars from the top of Mount Whitney This peak is the highest in the United States its altitude being 14 501 feet above sea level The instrument taken by the observers was a 16 inch horizontal reflecting telescope to which a suitable spectroscope was attached Of the seven nights spent by the men on the summit only two were clear enough for observation The spectrum of Mars was compared with the spectrum of the moon It is known that there is no water vapor on the moon certainly in no appreciable quantity If no difference can be detected between the spectrum of Mars and the spectrum of the moon under these most favorable conditions it *can* be said with *safety* that water exists on Mars in negligibly small quantities The results of this expedition have not as yet been published Readers of this column of science notes will doubtless remember that Mr Slipher of Prof Lowell s staff claims to have obtained spectroscopic evidence of the existence of water vapor on Mars

On July 26th, 1909 the Singles coal mine in the French district of Puy de Dome was the scene of an accident similar to that which occurred some time ago in the Gard mines At the Singles mine an interior shaft was being sunk for the purpose of determining the depth of the deposit. This shaft was sunk from a horizontal gallery which led from the foot of a shaft 1 000 feet deep The explosion of a powerful blast shattered the rock and caused the disengagement of great volumes of carbon dioxide, which filled the gallery and both shafts before all the miners could take refuge in the safety chamber This mine possessed no oxygen life-saving apparatus and the manager was absent at the time of the accident The life saving corps of several mines in the vicinity responded promptly to appeals by telephone but no effective work could be accomplished until several hours had elapsed Of twelve miners who had been entrapped seven had passed the day in terror in the safety shelter but the remaining five were found suffocated in the gallery.

HOW WE GET STANDARD TIME

BY HARLAN T STETSON

Although it may be generally known that the determination of time is the work of the astronomer yet doubtless few people stop to investigate the precise methods employed in the correction and distribution of standard time It is a system in itself quite indispensable to the success of the industrial world

The great universal timekeeper is the earth itself So uniform is the earth s rotation on its axis that the length of the day according to Newcomb has not altered the 1/100th and probably not the 1/1000th part of a second since the beginning of the Christian era The direct effect of this rotation is the apparent revolution of the celestial sphere or the daily motion of the sun stars and planets across the sky As places on the earth are determined by latitude and longitude so stars are located by right ascension and declination Every conspicuous star has its position carefully determined and from a star catalogue the astronomer knows at once the instant of culmination or meridian passage of any given star If then with a suitable instrument an observation of a star s transit across the meridian can be obtained and the time of its occurrence be noted by a clock or chronometer a comparison with the catalogue will disclose the amount by which the clock or chronometer is fast or slow Such an operation of finding the clock error is always what astronomers understand by the expression obtaining time The instrument used for making these observations is known as the transit instrument and consists essentially of a telescope so mounted as to be capable of swinging about a horizontal axis in the plane of the meridian The accompanying illustration shows such an instrument ready for the observation In the eye-piece of the telescope is placed the reticle comprising a number of spider webs of which the attached diagram shows five to be stretched vertically and two horizontally across the field of view The instrument is so adjusted that the middle one of the vertical threads coincides as nearly as possible with the imaginary circle in the sky called the meridian

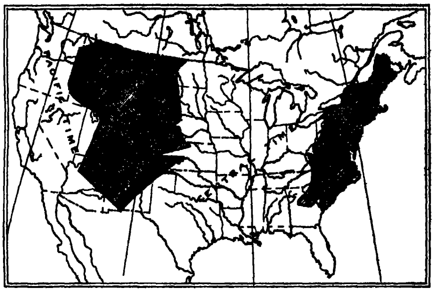
When observations are to be made for determining time the astronomer first turns to the *Ephemeris or some catalogue of stars* and selects a star which is soon to culminate then from the declination he mentally calculates the altitude at which the star will transit By means of a reading circle attached to the instrument he sets the telescope at the proper angle so that the star will pass through the field of view Either of two methods may now be employed in making the observations The first and older of the two is known as the eye and ear method This consists of watching the star pass through the field and while listening to the half second beats of the chronometer estimating to the nearest tenth of a second the time at which the star crossed each thread of the reticle In the chronographic method now much used the mind has less to do and hence more accurate results can be obtained Here as before the astronomer watches the passage of the star across the threads of the reticle but instead of estimating the time of transit he presses a telegraphic key at the proper instant The key is in electrical connection with an instrument called a chronograph and an automatic record is made of each observation Either method will leave a record for the five threads similar to the following the Roman numerals designating the number of each thread in order of observation

I			16 7
II			25 5
III			34 3
IV			43 0
V	7h	9m	51 7s
Mean	7h	9m	34 24s

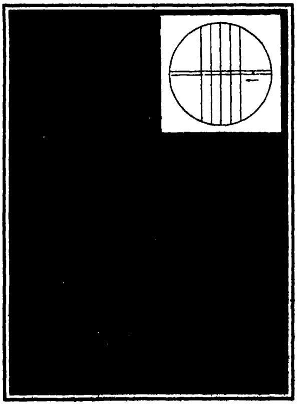
The above is the actual result of a set of observations made by the writer using the eye and ear method The figures in the seconds column were written immediately after the transit of each thread the hour and minute were filled in at leisure after the last observation

The mean of these observations will give a more precise result for the transit over the middle thread than a single observation could afford The exact right ascension of the star we will suppose to have been known as 6h 58m 19 96s which equaled the correct time of the star s transit The chronometer, however recorded the time of transit as 7h 9m 34.24s, and was therefore fast by the amount of 10m [illegible]

Were the instrument in perfect adjustment and were there no personal element to enter into the result such a set of observations would be quite sufficient. As a matter of fact, however there are always small errors in the instrument which must be determined and applied as a correction to the final result The astronomer therefore does not rely wholly upon a single record like the above but will usually repeat the observation with a number of different stars on the same night From these numerous records he is able to deduce the necessary corrections and thus obtain a more accurate value for the chronometer error Time thus determined ordinarily correct to within one tenth of a second is *sidereal* time and though very useful to the astronomer is quite unsuited to the use of the world in general whose activities are governed by the rising and setting of the sun and not the stars Sidereal time must therefore be converted into *solar* time This is easily effected by a simple calculation constantly employed by the astronomer Having then obtained solar time there remains only to distribute it to the outside world



STANDARD TIME BELTS OF THE UNITED STATES



AN OBSERVATORY TRANSIT INSTRUMENT FOR DETERMINATION OF STANDARD TIME DIAGRAM SHOWS RETICLE OF TRANSIT

Until within the last twenty five years each community used its own local time but as travel became more extensive it was found quite inconvenient to alter one's watch and system of time reckoning for every few miles of traveling east or west. Accordingly, in the year 1883 the United States adopted the present system of standard time. The whole country from the Atlantic to the Pacific was divided into time belts of ap- [illegible] belt, extending as far [illegible] of the 75th meridian, which is very nearly [illegible] Philadelphia, and is five hours slower than [illegible] time. Crossing into the "Central" belt, watches are set one hour earlier, as the time employed is that of the 90th meridian six hours behind Greenwich time. Similarly, "Mountain" time uses the 105th meridian, seven hours behind and the "Pacific" belt adopts the 120th meridian time, just eight hours slower than that of Greenwich Such a system is quite indispensable to railroad lines, and hence standard time is sometimes called "railroad time" At present almost every civilized country is using some system of standard time usually under the control of its own government.

The chief source for standard time in the United States is the Naval Observatory at Washington D C Here high-grade clocks are carefully regulated by observations of the stars at night, and all necessary corrections applied. For the five minutes preceding noon of each day, eastern time the Western Union and Postal Telegraphic companies suspend all ordinary business and throw their lines into connection with the Washington Observatory It is so arranged that the sounders all over the lines make a stroke each second during the five minutes until noon except the twenty-ninth of each minute the last five seconds of each of the first four minutes, and the last ten seconds of the fifth minute then follows the final stroke at exact noon. This affords many opportunities for the correction and setting of timepieces throughout the country The Western Union Company also operates a system of some 30 000 clocks which automatically set themselves by the noon signal each day

In addition to the Washington signals many smaller observatories determine and distribute time in a similar way to jewelers and local railroad lines In most of the larger seaports time balls are dropped at noon, and give mariners an opportunity to correct their chronometers Fire alarm companies aid in the distribution of time in many localities by sounding bells at certain specified times each day thus affording the public a convenient source of correct time with a reasonable degree of accuracy

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The Destruction of Rats with Carbon Disulphide.

M de Kruyff of the agricultural bureau of the Dutch Indies at Buitenzorg Java has published an interesting article on the destruction of rats The various contagious diseases which have been recommended for this purpose have been found useless in the tropics and have *not* always proved effective even in the temperate zone Hence De Kruyff's experiments will be of general interest. After working four years with numerous viruses without succeeding in creating an epidemic or even killing a single rat De Kruyff obtained more encouraging results by employing carbon disulphide in the following manner All visible ratholes were first stopped with earth for the purpose of ascertaining which holes were inhabited for the inhabited holes were found reopened on the following day Half a teaspoonful or less of carbon disulphide was poured into each of these holes and after waiting a few seconds to allow the liquid to evaporate, the mixture of vapor and air was ignited The result was a small explosion which filled the hole with poisonous gases and killed all the rats almost instantly A pound of disulphide costing about 16 cents, is sufficient for more than 200 ratholes; 131 dead rats were found in 43 holes which were opened after the operation In two cases, 10 rats were found in a single hole.

The process is, therefore very cheap and the results are immediate and absolutely certain.

* * *

It is calculated states a contemporary, that the United States is producing the following per week for fifty-two weeks in the year for every man, woman, and child of the population of ninety millions: Three-quarters of a pound of wire, more than three-quarters of a pound of rails, half a pound of structural [illegible], three-quarters of a pound of plates, [illegible] of a pound of sheets, three-quarters of [illegible] tin-plate, two and a half pounds [illegible] four pounds of [illegible] [illegible] iron and steel products [illegible] in [illegible] [illegible]

[illegible] SYSTEM OF SHIP CONSTRUCTION

The interest of the shipping world has been aroused by a new departure from the ordinary lines of ship construction, as exemplified in the steamship "Monitoria," which recently left the Hylton shipyards of Messrs. Osbourne Graham & Company of Sunderland. This vessel of 3,200 tons marks a new development in shipbuilding design being built upon what is known as the *Monitor* or corrugated system. For several years past experiments have been carried out by the Monitor Shipping Corporation of Newcastle-on-Tyne to determine the best method of increasing the longitudinal strength of a ship without any corresponding increase of weight. To this end the underwater part of the hull between the light and load lines was corrugated for almost the entire length of the vessel. Continued investigation and experiment resulted in ascertaining the definite form of this corrugation and at last it was resolved to test the system practically in a full sized vessel. The Ericsson Shipping Company of Newcastle-on-Tyne undertook to build a craft on these lines and the Monitoria now on her first trip was the outcome. The vessel measures 279 feet in length by 40 feet 1½ inches normal extreme breadth increased by the Monitor projection to 42 feet with a molded depth of 20 feet 7½ inches.

In the accompanying illustrations the forms of construction of the corrugation are clearly shown. The shell plating is swelled out in two places on either side longitudinally the curve being somewhat flat and the upper and lower edges curving gradually into the flat side of the normal vessel. The main frames measure 8 inches by 3 inches and the depth of the corrugation is 11¼ inches at the crown. Plain angles are attached to each main frame and a corrugation gusset plate at each frame. There are no side stringers.

The very important result is obtained in this design that the projections give considerable increase in the hogging and sagging strength so that the stress on the material is reduced at both keel and gunwale. The construction of the sides of the ship with these corrugations is rather an addition than a vital alteration of the main structural system and it can be applied to any type of steamship. The builders claim that the extra cost is slight and the dead weight carrying capacity is increased from three to four per cent. The coal bill is reduced from 1 to 15 per cent for the same speed or if the coal consumption is maintained as before the speed of the ship with the extra dead weight is increased from 0 2? to 0 knot according to the size and class of the ship.

These corrugations increase the stiffness and longitudinal strength of the vessel

THE MONITORIA —A CORRUGATED SYSTEM OF SHIP CONSTRUCTION

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THE GABET WIRELESSLY-CONTROLLED AUTOMATIC TORPEDO

On Wednesday June 23rd experiments were made with the wirelessly controlled torpedo of Gabet to which reference has already been made in these columns. In the experiments on the banks of the Seine endeavors have been made to control the torpedoes from a small boat about 100 meters (328 feet) distant from them containing a plant for producing Hertzian waves.

The torpedo motor was started and stopped at will and the rudder turned in every direction at the will of the man in the boat.

The improved Gabet torpedo consists mainly of a large cylinder terminating in two cones and forming the lower part of the apparatus. Some distance above about 1 meters (feet) there is another similar cylinder only smaller and intended to float. The lower shell is 9 6 meters long (31 feet).

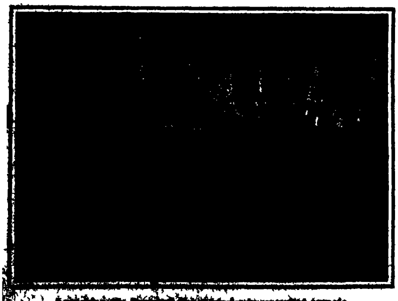
The two tubes are fastened together by a series of very strong steel tube frames. Besides these two other shafts rather large in diameter start from the lower body extend beyond the float and form two rather short vertical masts. Each one of these carries an acetylene light. They are connected by a copper wire.

Let us now examine the parts composing the lower shell which is the most important. It is divided into several compartments having each its particular use.

The first compartment is situated in the fore part of the lower shell. It contains the explosive charge and controls a warhead similar to the warheads of all present-day torpedoes which produce the explosion of the charge instantly on contact with a hard body such as the hull of a vessel.

While all ordinary torpedoes ar [illegible] to 100 kilos of explosive (1 4 to [illegible]) pounds the Gabet can take 9?0 kilos (1 98 pounds) with correspondingly greater destructive effect.

The Gabet torpedo contains an internal combustion motor operated by gasoline a decided novelty. Compressed air as now used in torpedo motors may supply powerful engines but the radius of action is very



[illegible] the [illegible] torpedo.

The wave-transmitting apparatus set up in a small boat

THE GABET WIRELESSLY-CONTROLLED AUTOMATIC TORPEDO limited The speed of torpedoes thus operated reaches 30 knots, or about 50 kilometers an hour

It is manifestly very dangerous to shut in a gasoline motor in a confined space or nearly so, as is the case here where communication with the outer atmosphere takes place only through the upper part of the foremast.

Ventilation is effected by means of a large blower, situated aft, between the motor and the chamber containing the storage batteries The precautions taken seem sufficient to dispel all fear of serious accidents

The motor is located in the compartment aft of the torpedo It is therefore entirely separated from the explosive charge with which it cannot communicate by any manner whatever

The torpedo used for the present experiments develops 30 horse-power It has a motor with eight cylinders arranged in V shape But the compartment is large enough for a 300-horse-power multiple-cylinder motor, which is necessary to impart to the torpedo the estimated speed of 20 knots, or about 36 kilometers an hour

Regarding weight, every necessary margin is allowed since the torpedo can carry 1 800 kilos (3,960 pounds) of ballast under present conditions, that is to say with a 30-horse-power motor This ballast represents the difference between the weight of an electric motor with its storage batteries and the weight of the internal-combustion motor developing this power

Gabet expects to attain a 10-knot speed with the 30-horse-power motor which he will use in his preliminary trials before putting in the 200-horse-power motor on which he relies to obtain the 20 knots that he considers sufficient speed

Endeavors have been made to obtain for this dirigible torpedo all the advantages that could be had on a real vessel In particular, it was sought to fit it with the means for maneuvering and altering the speed This problem seems strangely difficult of solution The trouble has been overcome by using a reversible screw with which it is only necessary to turn the blades so as to diminish their effectiveness on the water this promptly reduces the speed. By this means a propeller is obtained that acts as well moving forward as backward when given the same speed of rotation

There was another great difficulty to surmount before this screw could be used The power exacted from the motor varied considerably with the speed It became necessary therefore to find a way of reducing the power developed by the motor and of providing against its running away as the resistance of the propeller tended to diminish

To attain this end the spark is retarded as the speed of the torpedo is reduced The motor speed is thus gradually changed by the variation of the pitch of the screw This variation of pitch of the propeller has been availed of to act upon the timer of the motor

For that purpose the pitch-controlling mechanism has been connected with the timer by a jointed rod so that the spark advance is at its maximum when traveling full speed forward or backward The pitch controlling mechanism is also connected to the throttle valve in order to simultaneously diminish in certain proportions the volume of gas admitted

The third compartment of the torpedo contains a small storage battery This is not intended to drive the torpedo but to operate a relay that helps maneuver the boat under the influence of the Hertzian waves acting on special devices

The compartment back of the explosive charge contains the Hertzian controlling instruments They are sufficiently effective to act even at as great a distance as 8 to 10 kilometers (5 to 6 miles) from the transmitting station This distance is a convenient one at the present time for warships get into action at least at 7 or 8 kilometers (about 4 miles) away

We have said that the two masts of the torpedo carried acetylene lights These serve to show the position of the torpedo at every moment, and indicate clearly every change in its course.

It is absolutely necessary to know what is going on inside the torpedo and what influences may act upon it. For although the receiving instruments of the Hertzian waves have been made as perfect as possible, they may come under the influence of other waves than those sent from the transmitting station. In this case, the torpedo would obey other agencies and would deviate from its course

To remedy this serious objection lanterns have been disposed about to flash signals in such a manner that the operator placed on shore or on a ship, may recognize the nature of the directions received by the torpedo. In short every time the torpedo receives waves registered by its instruments, the lanterns show signals to indicate the direction of the torpedo If these signals lead the operator to believe that the waves come from the enemy he does what is necessary to rectify the course of the torpedo, and he nullifies the disturbing waves

We presume that the wireless control of the torpedo remains as we have previously described it. The reader interested in that phase of the construction is referred to SCIENTIFIC AMERICAN SUPPLEMENT No. 1650.

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THE "ZEPPELIN III." AIRSHIP AND ITS TRIP TO BERLIN.

The large photographs of the latest Zeppelin dirigible reproduced on our frontispiece this week give an excellent idea of this new leviathan of the air, which made its first long-distance flight from Friedrichshafen to Berlin a little more than a month ago.

The start of this memorable journey occurred at 4 35 A. M on August 27th. The airship started against a light northeast wind. Besides Engineer Durr and young Count Zeppelin (the nephew of the inventor), only three mechanics were carried The crew was reduced to but five men because of the uncertain weather and in order to reduce the weight carried as much as possible. The airship arrived at Ulm at 6 45 A. M., having made the 80 kilometers (49 7 miles) in two hours and eight minutes, at an average speed of about 23 3 miles an hour This speed was maintained up to Heidenheim, a place located on the frontier of Wurtemburg and Bavaria, which was passed at 7 30 A. M. Soon after Gingen was reached. The airship remained here about an hour and described circles, while all the time it was fighting against the contrary wind blowing from the direction of Wurtemburg Soon after Engineer Durr sent a telegram stating that the airship would be forced to land at Nuremberg, on account of a cracked cylinder in one of the forward motors in the forward car On account of this mishap, the speed was reduced considerably, the airship finally arriving at Ostheim near Gunzenhausen 21¾ miles from Nuremberg at 11 45 A. M. At this point a broken propeller—which was immediately replaced by an old one that was carried on board—made it necessary to land Advantage was taken of the landing to renew the water ballast. After a delay of 2½ hours, the airship started again at 2 10 P M for Nuremberg which was reached at 4 45 P M A landing was effected against a strong wind Before landing the dirigible described several circles, in order to give the 120 soldiers of the Fourteenth infantry regiment time to make preparations for anchoring it. When the airship alighted, the crowd broke bounds, and it was feared that they would damage it. Fortunately however, this fear was not realized

The start from Nuremberg was made the following day at 2 15 A. M At 4 A. M it passed above Bayreuth where it was buffeted by the wind for three hours. Engineer Durr dropped a card at 7 o clock stating that all was well on board. At 8 o clock the airship, still battling against the wind, returned to Bayreuth. It then resumed its journey, but was able to make a mean speed of only 14 kilometers (8 7 miles) an hour It passed Muuchberg at 9 40, Hof at 10 o clock, and Plauen at 12 10 P M It was making only 30 kilometers (18 64 miles) an hour Werdau was passed at 1 45 P M and although the wind had completely died out, the speed of the airship grew less and less It was hoped that it would reach Leipsig by 10 P M, when another accident occurred One of the blades of the propellers broke and it was only with the greatest difficulty that the airship was able to reach Bitterfeld It arrived at this place at 6 45 P M, having been driven from Eilemburg by a single motor A successful landing was effected

Repairs were made during the night, and the next morning at 7 30 A. M. the airship left Bitterfeld in a heavy fog. The fog dissipated rapidly, however, and when the airship arrived above the Tempelhof parade ground at Berlin at 12 30 P M., the weather was clear The Emperor and the other members of the royal family were on hand to receive Count Zeppelin, who had gone aboard his airship at Bitterfeld Emperor William introduced him to Orville Wright, and this meeting of the two champions of the heavier-than-air and the lighter-than-air type of flying machine was decidedly novel The landing of the airship occurred above the parade ground at Tegel, after it had first performed evolutions above the Tempelhof parade ground and afterward flown over the city of Berlin. One of our photographs shows the airship above the city, and the other shows it just before alighting.

The return voyage was started at 11 30 P M. the same day The airship followed the Wittenberg-Jueterbog railway line for a considerable distance, when it again met with another accident, due to the breaking of a propeller The blade tore through the envelope of the airship, and punctured one of the balloons. The accident happened near Bulzig, about 60 miles from Berlin and with the aid of some farmers, the airship was immediately brought to land in a field near the railroad track. The speed up to the time of the accident was extremely slow, and barely reached 20 kilometers (12 43 miles) an hour Count Zeppelin was not on board at the time of this accident, he having returned to Friedrichshafen by rail. The airship was obliged to remain at Bulzig for nearly three days. It was not until 10 53 A. M. on the morning of September 5th that another start was made. Ulm was passed at 7:45 P. M., and [illegible] at [illegible] P. M. The airship finally arrived at Friedrichshafen at [illegible] the following morning after a continuous voyage of 22 hours and 37 minutes. The average speed maintained from Bulzig therefore was only 14 3 miles per hour.

After the "Zeppelin III." had been repaired, an effort was made to sail it to Hergentheim, 130 miles from Friedrichshafen, to take part in the maneuvers; but the repairs were not finished in time, and the airship was unable to reach its place until the maneuvers were over Considerable excellent work was done, however, by the "Gross II" military dirigible at these maneuvers. This dirigible was able to reconnoiter from a great height and to send messages to the rear Emperor William was greatly pleased at the work done by this airship at the maneuvers.

The "Zeppelin III" is the largest and most powerful airship which Count Zeppelin has yet built. It has two 150-horse-power motors, each of which drives, by means of belts, two two-bladed propellers. These are located one on each side of the airship about a third of the way up from the bottom They are held upon brackets projecting out from the rigid frame. The driving of the propellers by belts is a new arrangement, as heretofore they have been driven by shafts and bevel gears. The stabilizing fins near the rear end are somewhat different from before, there being two upon each side placed above the center horizontal line of the airship. The up and down steering is accomplished by quadruple horizontal rudders on each side of the airship at the front and at the rear Besides this, water ballast is carried in a long tank connecting the two cars.

It is planned to use this airship for carrying passengers in different cities in Germany in the near future.

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The Current Supplement.

The opening article of the current SUPPLEMENT, No 1761, discusses the San Salvatore mountain railway of Italy Beautiful views of this picturesque road are published. The classification of chemical elements, in the light of Mendelejeff's great generalization, and in the light of the electronic theory, is considered by Prof H. E. Armstrong in a thoughtful paper A critical *résumé* of Prof Wood's experiments with rotating liquids used as mirrors is presented A perpetual clock is described by Charles E Benham A new system for the electrical transmission of pictures is described by Dr Robert Schoenhoefer Prof Albert F Ganz's paper on recent electrical progress in the artificial lighting field is concluded The great rise which is announced in the price of India rubber tires directs attention once more to the various and conflicting problems presented by the wheels of motor cars. These are critically considered Prof William H Pickering presents his view of the origin of meteorites, and advances the theory that meteorites are of terrestrial origin The disappearance of the Bosgoslav Islands is described Sir Norman Lockyer, the well known English astronomer has made a special study of the astronomical value of ancient temples. The result of his researches is presented in an article entitled "The Uses and Dates of Ancient Temples."

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The Death of Robert Hoe.

Robert Hoe, senior member of the well-known firm of R. Hoe & Co, printing-press manufacturers, of New York city, died in London on September 22nd, at the age of seventy Mr Hoe was for years the head and front of the extensive business founded by Robert Hoe in 1803 His devotion to the enormous enterprise with which his name was connected, was exhibited not only in an administrative capacity, but also in the suggestion of many improvements in printing presses. His invention of the rotary multi-color and half-tone web presses, now found in every newspaper and job printing plant, is perhaps his most important contribution to the printing art. Mr Hoe was the author of several books, most of them dealing with printing. Among them is a history of the development of the printing press from the time of Gutenberg down to the present day

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The railway from the Piræus to the Turkish frontier (246 miles) may be said to be practically completed, the section from Bralo to Larissa having been opened to traffic since October last, and trains now run in twelve hours from Athens to Larissa. The construction of the final section of 28 miles to the frontier is in an advanced state. There remains, then, in order to release Greece from the isolation which she is the last of European States to suffer, but 70 miles between the frontier and the nearest station on the Ottoman railway system. There appears no indication, however, of any disposition on the part of the Ottoman government to facilitate the construction of the junction line, and it will be regrettable if the reactionary government of Turkey continues to oppose a project so evidently appertaining to an era of civilization and progress.

On Waterproofing Concrete.

On account of the number of inquiries received from correspondents as to methods of waterproofing cement blocks or monolithic concrete, the SCIENTIFIC AMERICAN has been investigating what is being done in the way of improvement of existing methods.

The Concrete Association of America has conducted a valuable series of experiments and distributes its findings free of charge in a public-spirited manner, but the results obtained are largely negative.

Some preparations are found to be effective under certain conditions, but none hitherto has been found to be equally reliable with all mixtures and under all circumstances.

The need and requirements of external paint for concrete, if only to counteract the variable porosity which cannot be avoided unless the personal equation in concrete mixing is eliminated is so well put in a paper read before the recent convention of the American Society for Testing Materials, by Mr G D White, that we quote a part of it by permission

"Unless extreme care is exercised in the preparation mixing, and workmanship of concrete for solid or reinforced work which is not always commercially possible the resultant concrete is not impermeable or at least not uniformly impermeable to water or moisture. Where perfect materials have been used with perfect workmanship we have another difficulty, another problem to solve Concrete is a non-conductor of heat It is, naturally, a cold blooded animal The difference in temperature between the concrete wall and the atmosphere (the warmer the day the greater the difference in temperature) causes a condensation of moisture on the surface This is annoying and a detriment to health in living and office rooms a loss of room or loss by damage in storerooms and warehouses, an objection in any building, no matter what its nature or purpose

"Hollow concrete blocks, tiles brick etc have various defects They are not only porous but capillary positive, and thus absorb moisture from 5 to 40 per cent of their own weight Due to rain and snow walls built of these materials become water-soaked, and remain soaked for varying lengths of time During certain seasons of the year and especially in some sections of our country they remain soaked for months.

"The fact that dry walls are essential to health and comfort is generally known and so well appreciated that the question of dampness has been a restraining agent to a much larger and more extensive use of concrete by the building trades of this and other countries

The tendency to stain the frequence of efflorescence, and difference in color due to difference in materials and to intermissions in concrete are defects of a less serious nature

"A drawback that includes concrete in all forms is the uninviting, unattractive color Replace our buildings of marble of terra cotta, of granite of wood handsomely decorated, with buildings of concrete, and note the contrast The dirty gray of ordinary cement or concrete becomes monotonous to the observer even where there is but a sprinkling of concrete among buildings of more pleasing construction

"If to the strength cheapness, durability, and fire-resisting properties of concrete can be added impermeability to moisture and decoration we will have a building material as nearly perfect as the world has ever seen, and this within the means of every builder

"In recognition of this fact, various concerns and individuals have placed on the market and recommend as a solution to the problem, various treatments and coatings.

"For the sake of convenience, I will divide these into four classes In my investigation of the various treatments and materials included in these classes, I have endeavored to be unprejudiced, and to give to each its true worth and full value.

"I. WATERPROOFING COMPOUNDS IN LIQUID OR POWDERED FORM, MIXED WITH THE CONCRETE IN ITS PREPARATION

"This is a help in that it lessens and retards, in a measure, the moisture-absorbing tendency of concrete. It fails in the desired attainment for the following reasons

"Improper distribution, which is difficult of regulation.

"When properly distributed, it does not render concrete entirely impervious to moisture

"It has a tendency to weaken the tensile strength of concrete.

"It does not decorate.

"The increase in value is not proportionate with the increase in cost.

"It deteriorates with age, that is, a concrete block containing the waterproofing compound, on the first application of water will absorb certain varying quantities. On subsequent applications, allowing the block to dry in each instance, larger quantities are absorbed.

"II. TREATMENTS PREPARATORY TO THE USE OF LINSEED-OIL PAINTS.

"Treatments in various forms have been advanced and recommended by some of our leading master painters, and indorsed by most able research chemists. For the sake of brevity, I have included in my paper but three of these treatments

"(a) Hydrochloric or muriatic-acid wash.

"(b) A wash consisting of a solution of zinc sulphate and water

"(c) A wash consisting of ammonium carbonate and water

"From a chemical standpoint muriatic acid, no matter in what strength nor what the character of the concrete, is not only useless as a remedy, but detrimental in its action Master painters who have endeavored to put it in practice have discovered to their sorrow a confirmation or a demonstration of the chemical theory

"Theory favors and practical tests confirm as the best adapted to the purpose, the former of the two latter methods"

The author proceeds to give the chemical reactions of these various washes with the concrete ingredients, and shows in a convincing manner the reasons why they fail in their desired object He adds

"The treatment with zinc sulphate or ammonium carbonate, even though successful does not offer a solution to the problem because a linseed-oil paint is unsuited for either exterior or interior painting of concrete The gloss robs the surface of the appearance of stone or masonry Linseed oil has water-absorbing and lacks water resisting properties. It can not be applied over a damp or wet surface which means that following a rainstorm or rainy season a painter must wait weeks and perhaps months before he can commence work on or complete a contract already begun

"III COLORLESS LIQUID COATINGS

"Certain of these may be of some value or service in retarding moisture absorption and efflorescence but they are all alike found lacking in the following respects

"They serve to emphasize any defects in or difference in color of concrete construction

"They impart to concrete a soggy water-soaked appearance

"They do not render impermeable to moisture for any length of time

"They do not decorate"

Under his fourth heading Mr White summarizes paints for concrete with the practical conclusion that there are none which fulfill all the requirements of a severe list which he gives. The principal of these are that it must be applicable to a wet surface and at the same time waterproof when set It must be applicable to the concrete without previous treatment of the latter durable economical and pleasing to the eye must act as a bond between concrete and a plaster coat and remain hard in the presence of water In addition to possessing all the qualifications of ordinary paint such as working well under the brush filling voids and leveling up irregularities of surface

Although Mr White did not say in his paper that he knew of any satisfactory paint we have reason to believe that he has been instrumental in the production of one, or at least that it has been developed with a special view to fulfilling the requirements outlined in his paper

We have recently seen tests, and the results of long-continued tests of a paint called Cementhide which seems to fulfill all the exacting conditions above referred to

At a cement block factory in Newark, N J a part of the process consists of the curing of the newly made blocks by subjecting them to steam for thirty six hours, accelerating their setting and providing a much more constant and uniform supply of moisture to the cement than can be obtained by spraying

For this purpose two curing rooms are used, each of which is opened to be emptied and refilled on alternate days, the steam being turned off in the morning and on again at night. The steam is therefore continuously applied to the interior of the walls for 36 hours out of every 48 The rooms themselves are built of concrete blocks, and were formerly constantly saturated with moisture It was evident from the outside which room was filled with steam from a thin film of moisture trickling down the exterior of the walls, which had to be drained away Six months ago the interior was painted with two coats of Cementhide and now there is no evidence of moisture on the outside of the walls, while the interior has a smooth hard surface differing little from that of well-finished cement except in its pleasant color

Blocks made as identically as possible from one batch of concrete have been tested under varying conditions, one plain and the other painted The unpainted block was found to vary in weight with the water, absorbing it according to the amount present in the atmosphere or from the ground, while the weight of the painted block varied not at all. Blocks painted in a variety of pleasing colors have been left exposed to sun, rain, and wind for months without being apparently affected Concrete painted with this material takes a plaster coat better than natural concrete, both concrete and plaster adhering to the paint more firmly than they do to each other It has even been shown that the rise of moisture by capillarity in monolithic concrete set in moist ground is stopped by a coat of Cementhide between the top of the underground concrete and the masonry or other concrete continuation upward of the wall The paint has a dull finish not unlike the concrete itself, but smoother and of any color desired, and appears to remain hard and to preserve the surface of the concrete indefinitely One cannot imagine a more severe test in any ordinary building than that imposed at the block factory above mentioned and it would seem that this paint should have widespread possibilities when it is sufficiently introduced on the market.

THE MODERN ICARUS

BY JOHN ELFRETH WATKINS

Tradition asserts that the first to sacrifice himself to the problem of flying was Wang Tu a Chinese mandarin of about 2 000 years B C who having had constructed a pair of large parallel and horizontal kites seated himself in a chair fixed between them while forty-seven attendants each with a candle ignited forty-seven rockets placed beneath the apparatus But the rocket under the chair exploded burnt the mandarin and so angered the Emperor that he ordered a severe paddling for Wang

Then there is left in stone a partial account of experiments by Mau U an Assyrian priest who attempted to fly from the temple of Baal The next victims of aviation whom we find are certain criminals whose arms and legs the ancient Leucadians annually fitted with wings of various design and who were then hurled from the Rock of Sappho's Leap" a boat awaiting them in the sea below to give them liberty should they succeed in solving the problem

The first fatality of the kind in our era seems to have been a Roman who during the reign of Nero attempted to fly high in the air over the Eternal City During the Dark Ages one Dante while trying to fly with a pair of wings at Perouse fell upon the top of St Mary's Church and broke his leg The Prior of Tongland in 1510 before the Court of Stirling donned feathered wings and leaping from a tower of the castle fell into the "mydding" (dunghill) Allard a tight rope performer was crippled by a fall while trying to fly before Louis the Grand at Paris about 1660

Thus far all such accidents were results of attempted aviation for the balloon was not invented until 1783 when this new vehicle of the air met with an accident in Philadelphia during some experiments by Rittenhouse and Hopkins who after sending up dogs and cats in a cage carried by a captive bunch of 47 hydrogen balloons persuaded James Wilcox a carpenter to trust himself in the cage After floating over the city he found himself drifting toward the Schuylkill River and becoming terrified lest he should descend into it, punctured some of the balloons Coming to earth with a thump he broke his wrist

The next victims, Pilatre de Rozier and M Romain set out from Boulogne in 1785 in a car supported by a fire balloon underneath a hydrogen balloon with which compound arrangement they expected to cross the English Channel In a quarter hour when at a height of 3 000 feet the apparatus took fire and the scattered fragments were found upon the seashore along with the awfully mangled bodies of the aeronauts. Next Olivari ascending from Orleans, in November, 1802, also met death by his balloon catching fire

In April 1808 M Mosment ascended at Lisle waving a flag decorated with the imperial eagle of France and the assembled spectators shouted with delight He dropped an animal attached to a parachute and it came safely to the ground Later a murmur of horror rolled over the crowd which learned that in one of the ditches outside the city M Mosment had been found lifeless and covered with blood The same day the balloon came down seventy miles away

In July four years later the corpse of Bittorff after his balloon had caught fire was found stiff and cold upon the roof of a house outside Mannheim Shortly afterward Count François Zambeccari tried, like Rozier and Romain to combine the fire and gas balloon but after adding flame to powder he crashed down from the heavens his body charred and mutilated being picked up near Boulogne

Mme Sophie Blanchard widow of a French aeronaut made an ascent July 1819 in the presence of a vast crowd from the Tivoli Garden Paris, setting off fireworks as she rose Suddenly a great flash was seen above her basket and the crowd thinking this to be a part of the display, shouted "Bravo" But the flames were seen to spread and the balloon to come down Her basket caught against the projection of a roof and spilled her out upon the pavement where she was picked up dead

The first military martyr was Lieut Harris of the British navy who in May 1824 while studying the strategic value of balloons attached to warships was dashed to earth and killed by the breaking of a valve in his balloon And in September of the same year

Windham Sadler going up from Blackburn England was dropped to his death near Bolton his balloon having collided with a chimney

When John Wise greatest of all American balloonists abandoned his muslin balloon in 1836 for the "Meteor" wrought of silk he went up in it from Lancaster Pa on a showery day in May He sailed to the southward and was soon lost in a big black cloud That night he descended near Port Deposit Md and mooring his balloon near a farmhouse aroused the family It was drizzling and he was discharging the gas from the upper valve when someone brought a light exploding the gas in the heavy atmosphere Wise was thrown back ten feet severely scorched and some of those gathered round were badly burned Wise was taken to Philadelphia where he recovered

In July 1837 an immense crowd gathered in Vauxhall Gardens London to see an aged savant Robert Cocking test his new parachute It was of Irish linen had a circumference of 107 feet and was fastened below the basket of a balloon wherein two aeronauts were stationed Mr Cocking got into the smaller basket of the parachute and the big balloon after taking him slowly up drifted gracefully away But a rider following on horseback arrived at a field near Lee in Kent just in time to find the dead body of Cocking who had fallen through the air a mile in the collapsed parachute

Another victim of the parachute was Latur killed in 1854 while attempting a descent and soon afterward Arban of France while rising in a balloon from Barcelona was blown into the Mediterranean and lost Then in 1850 Gale made a fatal flight while in 1863 Chambers was suffocated by balloon gas in England

In 1873 at Ionia Mich the populace cheered as the brave aeronaut Mountain rose from their midst in his big balloon He floated gaily aloft at first but suddenly the fastenings of his basket gave way and he fell from such a height that his body penetrated the earth for some distance

And next came the first recorded fatality from winged flight since the Dark Ages Vincent de Groof renowned as the "flying man" while giving an exhibition at London in July 1874 fell suddenly to earth where his corpse was picked up with the stilled wings attached

In 1875 [illegible] Croce-Spinelli and Sivel two French savants while attempting to break the record for altitude in their balloon "Zenith" rose so high above France that the intense cold deprived them of power to descend When the "Zenith" came down they were found frozen to death in the basket During the siege of Paris two balloons with escaping passengers drifted off to sea never to be heard of and in 1888 the corpse of Simmons who had ascended from Olympia, came to earth near Malden

Hiram Maxim a few years later spent $100,000 on two immense heavier-than-air flying machines the last—which weighed 8,000 pounds making a false start in July 1894 when the machine ran off the guard rails Maxim gave up in disgust and turned to other problems

Then in 1896 Otto Lilienthal of Berlin after a quarter century of tedious experimenting brought forth a double-decked aeroplane in which he soared through the air at racehorse speed sixty or seventy feet above ground Prof Robert W Wood of Johns Hopkins University went over to Berlin to test the apparatus and made the snapshot used herewith A few days after this picture was taken Lilienthal fell from the same apparatus in the same spot and was picked up dead Shortly afterward the experimenter Pilcher who had been continuing Lilienthal's methods in England met death in much the same way

The same year S A Andree of Sweden accompanied by Nils Strindberg and Dr Fraenkel two other adventurous Swedes started in his balloon from Spitzbergen in search of the North Pole and no trace of them has since been found

In 1896 the hope of science was renewed by Langley our great astronomer and physicist who after a decade of the most careful experimentation flew a steam aerodrome three quarters of a mile over the Potomac This not being large enough to carry its engineer the army allowed the inventor $50,000 with which to perfect a man-carrying machine The quarter-size model of the latter also soared successfully over the Potomac in the face of the wind but when the full-size aerodrome was about to leave the launching track a defective part of the launching apparatus caught it and precipitated it engineer and all into the water Although the big aerodrome never had a chance to try its wings the press so ridiculed the enterprise that appropriation for repair was refused and Langley despite his other great contributions to science died a disappointed man

Count Zeppelin's new craft [illegible] feet long was making a long official test splendidly in August 1908 when the balloon caught fire

And finally comes Orville Wright riding to victory in his heavier-than-air machine which is scarcely inside the goal when it dumps him out with a broken thigh and several fractured ribs and with him spills

False start of Langley's "aerodrome," 1903.

Otto Lilienthal [illegible] fatal flight

Langley's last model. Telephoto snapshot of it in flight

John Wise

Otto Lilienthal

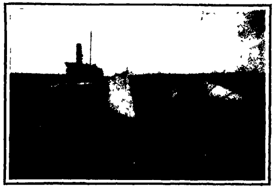
S A. Andree.

Samuel Pierpont Langley

Copyright 1908 by Waldon Fawcett

Orville Wright

Lieut Thomas E Selfridge.



Towing wreck of Langley "aerodrome" back to houseboat, 1903.

Langley aeroplane in the Potomac River

Sir Hiram Maxim

Lefebvre's machine after the accident.

Lefebvre, who was killed in France.

Captain Ferber

Ferber's aeroplane No IX

THE MODER[illegible] ICARUS.

to earth young Lieut Selfridge whom soldiers solemnly bear on a litter to the military hospital where occurs three hours later one of the more recent of the many fatalities of our chronicle of tragedy

The two fatal accidents which have occurred in France with the motor-driven aeroplane within the last few weeks have further dampened the enthusiasm of many would-be aviators The first of these which happened on September 7th resulted in the death almost instantly of Lefebvre who was one of the newest and presumably the most daring of all the French aviators The second one which occurred only last week (September 22nd) snuffed out the life of Capt Ferber who was probably the best known theorist and practician in the art of aviation in France Both of these accidents occurred while the men were trying out new machines In the case of Lefebvre he was making his first flight with a new Wright biplane The machine rose in the air without difficulty and flew for some distance in a straight line Lefebvre made an excellent turn and was flying back again in a straight line when suddenly the machine dived to the ground striking its head on with terrific force The motor fell upon the aviator who was crushed and had his skull fractured

Capt Ferber on the other hand was experimenting with a new Voisin aeroplane He had flown half a mile at a height of about [illegible] feet and was making a turn when the machine tipped a great deal and also dropped on the turn so that the end of the lower plane struck the ground The machine reared on its nose and Ferber was thrown to the ground the motor falling upon him He managed to extricate himself and was able to walk to the grandstand with the aid of some spectators He said that he had flown too low and that he had been bothered by the wind in making the turn He was not seriously injured to all appearances but in a few minutes a hemorrhage set in and he died before a doctor arrived The machine was badly damaged and it was a wonder that the aviator was not instantly killed Capt Ferber probably did more than any other man to bring the art of aviation to its present advanced point He was much of a theorist and only lately he published an article in which he deplored the weight of the present-day machines and gave it as his opinion that no progress had been made in perfecting these during the past six months The fatal accident which occurred at Boulogne was preceded by another bad smash less than a week before In this instance the machine broke a rudder and one of the planes

* * *

Rate of Helium Production

In a recent issue of Nature Mr R J Strutt contributes a communication on "Rate of Helium Production from the Complete Series of Uranium Products"

A knowledge of this constant is essential to the estimation of the ages of minerals from their helium content In a paper published in Proc Roy Soc July 28th 1908 Mr Strutt gives the age of some minerals provisionally on the assumption that the rate was 9.13×10^{-8} cubic centimeters per gramme U O per annum This rate was calculated from Rutherford's indirect data It has received much support from Sir J Dewar's determination of the rate of production by radium with its immediate products Mr Strutt is now in a position to confirm it further by an experiment on the rate of growth of helium in a solution of pitchblende He speaks of a solution but it has been found impracticable to take up all the constituents by one solvent Two solutions were necessary

The pitchblende solutions contained 11 grammes of U O and yielded in sixty-one days a quantity of helium which was measured as 2×10^{-7} cubic centimeters in the capillary of a McLeod gage This gives the rate as 10.4×10^{-8} cubic centimeters per gramme U O per annum No stress can be laid on the close agreement with Rutherford's estimate in view of the very small gas volume measured The experiment proves however that that estimate is of the right order of magnitude Larger scale experiments are in progress and these in connection with similar experiments on thorianite will it is hoped enable data on the quantity of helium in minerals to be translated into estimates of time with full confidence

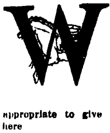
* * *

Railway Tree Planting

The Pennsylvania Railway is planning to set out more than 1,000,000 trees This will make a total of [illegible]430,000 trees planted in the last three years to provide for some of the company's future requirements in timber and sleepers This constitutes the largest forestry plan yet undertaken by any private corporation Heretofore the company's forestry operations have been confined to a limited area between Philadelphia and Altoona This year however [illegible] trees are being set out on tracts of land near Metuchen and New Brunswick N J In addition there are to be planted within the next month 207,000 trees near Conewago Pa 186,000 in the vicinity of Van Dyke [illegible] at Lewistown Junction 7,000 at Pomeroy, and [illegible] at Denholm

THE HEAVENS IN OCTOBER.

BY HENRY NORRIS RUSSELL, PH.D



WHAT astronomical problem has been so much before the public during the past month as this How can a man determine when he is at the north pole?

As many incomplete or misleading answers have come to the writer s notice it may be appropriate to give a brief review of the matter here

An observer standing at the earth s north pole would have the celestial pole (not the pole star which is 1¼ deg distant) in his zenith The stars during the long night would appear to circle round the sky from left to right always at the same altitude above the horizon the sun to circle similarly, rising slowly from the horizon to its maximum altitude of 23½ deg between March and June, and sinking again until its disappearance in September The change in the sun s altitude from day to day (which equals that in its declination) is accurately known, and can be taken from a small and easily portable table

For an observer near but not at the pole, the celestial pole would be displaced from his zenith—toward that point of the horizon where the earth's pole lay—by one degree for every 60 nautical miles of distance The stars—or the sun after allowance is made for its change of declination—would still appear to circle round the heavens but would be lowest when due north—i e, toward the pole—and highest when due south The whole change in their altitude would equal twice the observer s distance from the pole For latitudes up to 80 deg or more (that is more than five or six hundred miles from the pole) this change in altitude is very conspicuous and observations can easily be made when the sun is highest (at local noon) in the manner familiar to mariners But for an observer within a few miles of the pole these changes in altitude would no longer be perceptible to the eye and it would not be obvious in which direction the pole really was To make quite sure it would be necessary to observe the sun s altitude at intervals during the day and also its compass bearing (The compass of course which points toward the earth s magnetic pole 2 000 miles away would be as good a guide there as here but of no service at all in finding the geographical pole) It would then be necessary to march toward that compass bearing in which the sun had the lowest altitude (corrected of course for changes in declination) The distance to the pole in sea miles would be half the difference of the greatest and least altitude in minutes of arc, so that it would then be easy to advance to the right spot—in theory at least'

This discussion tacitly assumes that the observer is on firm land On the drifting polar ice the change in his position during the day would complicate matters. But by making observations for a second day the amount and direction of the drift could be determined for the sun s altitude (still corrected for changes of declination) would be greater in the direction of the drift and less in the opposite direction than on the previous day by the amount of the drift The explorer would then have all the information necessary for his purpose

One other point may be mentioned The sun's altitude must of course always be corrected for refraction in the usual way But since the sun's altitude is practically the same all day long the refraction will be constant (except changes due to weather conditions which would probably be very small) The observer s position and drift which are determined from differences of the observed altitudes will therefore be practically independent of the refraction corrections, and also of any "constant errors" of the instrument.

If the conditions of observation were as good as regards temperature and comfort as lower latitudes, an observer of moderate capacity, with portable instruments (sextant, artificial horizon, and chronometer) should be able from two days' observations to find both his position and rate of drift with an uncertainty of only a few hundred feet. Under the actual conditions at the north pole, everything would depend on the experience and skill of the observer, but in any case, he could fix his position with an error which would be quite imperceptible on even the largest-scale maps of the polar regions.

THE HEAVENS

Our map shows the aspect of the evening skies and shows, too, at a glance how dull the southern and eastern skies would be were not Mars and Saturn there to brighten them

The most prominent constellation there is Pegasus, which lies high up south and east of the zenith It may be instantly recognized by the Great Square—about 15 deg on a side, composed of second-magnitude stars, and standing decidedly alone—which is one of the principal landmarks of the sky for the beginner, as it has no counterpart in the heavens. One of its four corners now belongs to Andromeda, but it was once grouped with the other three and evidence of this still remains, for the letter Delta, which it bore as a member of the constellation, is now lacking from the list of the stars of Pegasus The rest of the constellation, extending westward from the Great Square, contains some remarkable double stars (observable only with great telescopes) but nothing to detain us. Our initial letter shows how this constellation, large as it is, is supposed to represent but a part of the winged steed of classic mythology Any actual resemblance would indeed be difficult to trace.

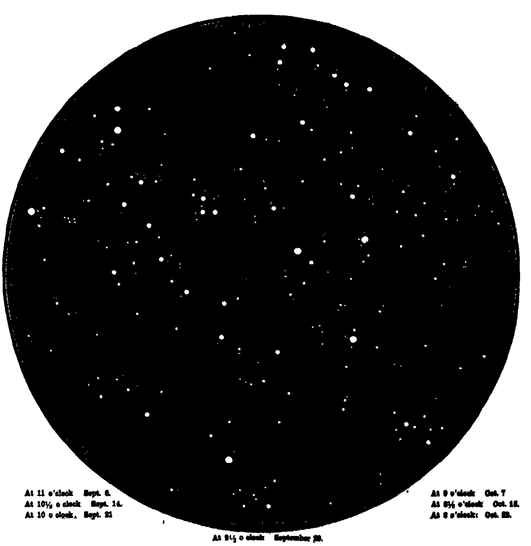
The western edge of the square continued far southward points out the isolated bright star Fomalhaut. The remaining stars of the Southern Fish, though too faint to be shown on the map, are easily visible on a clear night, forming a horizontal line just below the bright one

The equally lonely star some distance east of Fomalhaut is Beta Ceti The rest of the constellation follows this to the eastward. First comes a quadrilateral of which the southernmost star τ is one of our nearest neighbors. Then comes the notable variable Mira—also not far from us in space, and now brightening up and visible to the naked eye, and lastly a group, only the brightest two of which appear on the map. The whole constellation extends over more than 40 deg. and is one of the largest, though not the most conspicuous, in the sky. Above these constellations are the dullest of the zodiacal ones—Capricornus, Aquarius, and Pisces. The second of these, however, now contains the splendid Mars, and the last the less brilliant but still conspicuous Saturn, which both far outshine any stars within a long distance.

The line of stars running to the left from Pegasus, beginning at the northeast corner of the great square, contains the principal stars of Andromeda. Above the middle one of the three, near the second of two small stars, is the Great Nebula, the brightest in the heavens, concerning whose constellation and the problems which it still presents, we spoke a few months ago.

Below this is the inconspicuous but ancient group of Triangulum, and the smaller and brighter one of Aries. The Pleiades are visible north of east, and Aldebaran is just rising

Auriga in the northeast is a little higher up Above it, in the Milky Way, we come in succession to Perseus, Cassiopeia, and Cepheus; then passing the zenith, to Cygnus, Aquila, and Sagittarius (just setting) Ophiuchus and Serpens are also disappearing, due west. A little to the right is the Northern Crown, with the "keystone" of Hercules above it, and the steel blue Vega still higher The Great Bear swings low on the northern horizon, and the Little Bear, enfolded by the Dragon, is higher up



At 11 o'clock Sept. 6.
At 10½ o clock Sept. 14.
At 10 o clock. Sept. 21

At 9 o'clock Oct. 7
At 8½ o'clock Oct. 15.
At 8 o'clock: Oct. 22.

At 9½ o clock September 29.

NIGHT SKY: SEPTEMBER AND OCTOBER

THE PLANETS

Mercury is evening star until the 12th, when he passes on this side of the sun and becomes a morning star He reaches his greatest elongation west of the sun on the 27th, about which date he rises a little before 5 A M, and is easily visible before day break being situated in Virgo a few degrees above the bright star Spica, which however is not as bright as he is

Venus is evening star, and is very bright, but not very conspicuous because she is so far south. During the month she passes from Libra through Scorpio into Sagittarius, and at its end she is 26 deg south of the celestial equator In one latitude she sets a little after 7 P M but for observers in the southern hemisphere she remains in sight three hours longer, and is remarkably prominent

Mars is on the borders of Aquarius and Pisces, rising before sunset, and visible almost the whole night. He moves westward among the stars, ever slower and slower, until the 26th, when he begins the eastward march, which will take him over more than a whole round of the zodiac before another opposition

Jupiter is morning star in Virgo, rising about 5 15 A M. on the 1st, and 3 40 on the 31st, that is, about an hour earlier than Mercury at the time the latter is best seen

Saturn is in opposition on the 13th, and is well observable all through the month. His wings are by this time pretty widely opened out, and he is a very beautiful telescopic object.

Uranus is in quadrature, east of the sun, on the 10th, and south at 6 P. M. Neptune, in almost the opposite quarter of the sky, is in quadrature, west of the sun, on the 15th, and crosses the meridian at 6 A. M.

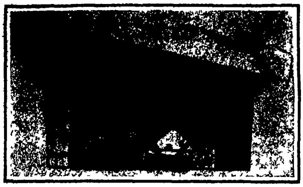
THE MOON

The moon is nearest us on the 27th, and farthest off on the 13th. She is in conjunction with Neptune on the 6th, Jupiter on the 13th, Mercury on the 15th, Venus on the 17th, Uranus on the 21st, Mars on the 26th (early in the morning), and Saturn on the 27th. On the evening of the 20th she occults the bright star Sigma Sagittarii (in the Milk Dipper). As seen from Washington, the star disappears behind the moon's dark limb at 7:01 P. M. and reappears on the bright side shortly at 8 o'clock.

Patent Department

SELF-CLEANING ASHPANS FOR LOCOMOTIVES.

A patent has been recently granted on an ashpan for locomotives, which is provided with novel means for cleaning out the ashes. Our illustration shows a locomotive ashpan fitted with the improved apparatus, and partly broken away to show the details There are, in reality two ashpans one placed before the other and each provided with hoes attached to a piston which may be operated to hoe the ashes out of the pans. The forward pan is provided with two hoes *A* and *B* while the rear pan has but one, *C* Between the two ashpans is a cylinder *D* which is fed with steam through two pipes *E*, that enter at opposite ends of the cylinder The piston in the cylinder is provided with a rod *F* at each end to which the hoes are attached The cylinder *D* is supported between the pans by means of a pair of brackets *G* The forward end of each pan is provided with an outlet normally closed by a damper The rear of each pan is also provided with an opening through which the ashes may be discharged and the rear ends of the hoes *B* and *C* are of such form as to enter and close these openings when they are forced back to the position shown in the illustration When the hoes are moved forward the dampers above referred to are opened by means of forwardly-projecting blades on the hoes *A* and *C* The bottom plate of the forward ashpan is also provided with a discharge opening, which is intermittently opened and closed as the hoe *A* passes over it. The steam pipe *E* leads up to a three-way valve, located at the boiler head in a convenient position for operation by either the engineer or the fireman, who may by this means reciprocate the hoes in the ashpan, and thus cause the discharge of the ashes. The inventor of this improved locomotive ashpan is Mr James S Downing of 185 Cooper Street Atlanta, Ga.

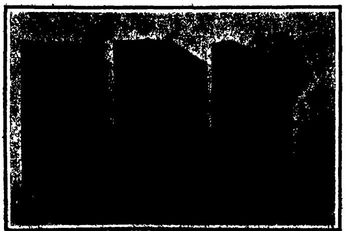


SELF-CLEANING ASHPANS FOR LOCOMOTIVES.

◆

SANITARY REFUSE RECEPTACLE

The ordinary refuse receptacles used in public places are merely open cans in which garbage ashes, or other waste material is placed The fact that these cans are open is a serious objection, because it permits the breeding of germs which may be infectious. Furthermore, it is a temptation to throw lighted matches or cigar or cigarette stumps into the can, and set fire to the contents. To obviate these difficulties, a new type of refuse receptacle has recently been devised which is illustrated in the accompanying engraving It is so arranged that the opening through which the refuse is introduced automatically closes, and in addition to this, the can is provided with a receiver for disinfecting material which will keep the contents in as nearly a sanitary condition as possible Fig. 1 shows the receptacle closed The top or lid of the receptacle may be swung open, as indicated in Fig 2, to permit of dumping the contents of the can The cup of disinfecting material will be observed at the center of this lid. Fig 3 shows the receptacle, with the inlet door open to permit of introducing refuse A spring is attached to the door at the inside, and serves to draw the door shut as soon as it is released When the top of the can is open, as in Fig 2 the lid is fastened to a catch at the front of the receptacle, and this prevents the inlet door from being swung open while the receptacle is being inverted to remove the contents The inventor of this refuse receptacle is Mr Vincent Azzara, 24 Washington Street, Morristown, N J

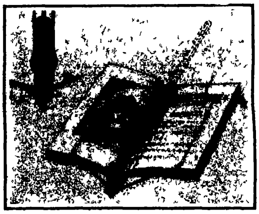


SANITARY REFUSE RECEPTACLE.

◆

CONVENIENT BOOK HOLDER.

Pictured in the accompanying engraving is a holder for magazines and other books designed to hold the book open at any desired point and support the book at each side The cover supports of the holder are adjustable to support the book either fully open or closed, or to support the separated portions of the book in an intermediate position The construction of the device is shown in the fragmentary detail view It consists of a spring clip or gripping device *A*, in the form of a relatively long trough like member of sheet metal which grips the bound edge of the magazine or book Within the clip is a tube *B* which extends beyond the ends of the clip *A* At the upper end of the tube *B* a plug is fitted to snugly engage a rod *C* This rod is provided with a head at the lower end as shown in the detail view which is adapted to contact with the inner end of the plug and prevent the rod from being withdrawn entirely from the tube *B* The rod *C* is bent upon itself into a U form while the outer extremity is turned up to prevent it from digging into the book The cover supports *D* consist of wire wings hinged to the extremities of the tube *B* A wire clip is bent over the hinged ends of the wings and acts as a stop to prevent them from being opened too far In application the clip *A* is passed endwise over the bound edge of the book, and the wings are slightly separated to admit the book between them The book is opened to the desired point, moving the wings outwardly on their hinges, and then the rod *C* is withdrawn from its tube, to the position shown by dotted lines slipped over the open book, and pressed back to its normal position as indicated by full lines In this position the two portions of the book are pressed against the wings and the book may be conveniently held with one hand by grasping the clip *A* which serves as a handle The hinges of the wings are sufficiently stiff to hold them in any position in which they are set Mr Albert F Stone, Jr of Callahan Cal is the inventor of this improved book holder

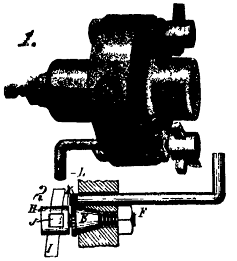


CONVENIENT BOOK HOLDER.

◆

IMPROVED CUTTER HEAD

The cutter head which is illustrated in the accompanying engraving is so designed that the cutting tools may be readily attached or detached at will and may be adjusted as desired without removing them from the cutter head The body of the device which is indicated at *A* consists of a cylindrical barrel having substantially the form of a cup with a flange formed thereon The driving spindle is adapted to enter the barrel, and the cutter head is adjusted thereon by turning the end screw A set screw *C* serves to hold the cutter head to the shaft. A series of conical apertures *D* are formed in the flange They are adapted to receive the split nuts *E* through which the screws *F* are threaded The screws *F* are prevented from turning by means of set screws *G*, which enter keyways therein but by means of nuts on the end of the screws the conical nuts *E* may be snugly seated in the openings *D* The upper end of each screw *F* is provided with a tool holder *H*, adapted to receive a tool or bit *I* which is held in place by means of a set screw *J* Each conical nut is formed with teeth at its outer end adapted to engage a pinion *K* on the end of the key *L* By inserting this key through the apertures from the rear of the cutter the bits may be adjusted at will without removing the cutter head, and then the screws *F* are made fast by tightening up the nuts at the rear The bits may be cut from air-hardening steel of any shape The inventor of this cutter head is Mr John F Stedman of Newberg Ore.

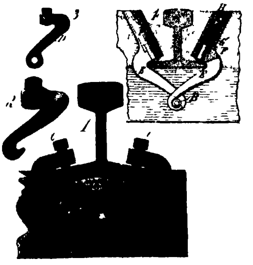


IMPROVED CUTTER HEAD

◆

RAIL FASTENER

The usual method of fastening a rail to the ties has this disadvantage that the base flange of the rail acts like the claws of a hammer under a nail head, to pry the spike out of the wood A better construction would seem to be one in which the axis of the spike lay at right angles to the pull of the rail base With a view to providing such a construction a new type of rail fastener has just been invented which is shown in the accompanying engraving The fasteners may be applied or removed without the use of a hammer and are adjustable to compensate for shrinkage in the ties Fig 1 shows a cross section of a rail fastened to a tie by means of two of the improved rail fasteners *A* The rail fasteners as indicated in Fig 2 are formed with hooks at the lower end adapted to engage a pipe *B*, preferably of cast metal which is fitted into a hole in the tie. The upper end of each fastener is provided with a threaded aperture in which a bolt *C* is fitted. The bolt is adapted to be screwed down on the base flange of the rail Fig 3 shows a slightly modified form of the fastener For street railways a different construction is required as indicated in Fig 4 Here the fasteners *E* are formed with threaded sleeves *F* Screw plugs *G* are adapted to be screwed into the sleeves *F* so as to bring their lower points into contact with the base flange of the rail The rail and fasteners are imbedded in concrete or the street paving material, with only the upper ends of the sleeves exposed It is merely necessary to tighten the screw plugs *G* once in a while by inserting a key wrench in the sockets *H* The inventor of this rail fastener is Mr George Dorffel Fruitvale Cal



RAIL FASTENER.

RECENTLY PATENTED INVENTIONS.

Of General Interest.

SWIVEL AND EXTENSION CONNECTION FOR SUCTION PIPES OR HYDRAULIC DREDGES.—J. W. Sackett, Jacksonville, Fla. This connection is to take the place of the ordinary suction hose and the ball and socket joint now used and arranged to permit the drag to readily accommodate itself to irregularities in the bottom of the water *way to be dredged and to change its relative* position with respect to the dredge as the demands of the practical work require and without causing any undue stresses on the suction pipe or the hull of the dredge.

HEAD REST.—E. C. Leahy, Sydney, Nova Scotia, Canada. When used in connection with reclining chairs the invention consists of a head block supported on a universal joint and having head supports with means for locking the joint and supports in adjustable positions, and as a pillow the same general construction is employed, and is supported on the top of a casing vertically adjustable relatively to the casing body. It is for use by barbers, parlor cars, dentists, etc., and as a pillow for campers, patients, etc.

HOLDER FOR ABSORBENT COTTON.—W. J. Durant, Spencer, Iowa. The invention relates to a holder adapted to receive a roll of cotton, and which is adapted to enable the cotton to be withdrawn as desired while at the same time it is fully protected from dust and dirt. It is especially useful in the offices of surgeons and pharmacists and in dispensaries and hospitals.

NON-REFILLABLE BOTTLE.—J. Bornstein, St. John's, Newfoundland. The object here is to provide a bottle arranged to effectively close the bottle when not in use, to allow convenient pouring of the contents of the bottle into a glass or other receptacle and to prevent unauthorized persons from refilling the bottle with spurious goods.

PAVING-BLOCK.—D. Atherton, Philipsburg, Pa. The aim in this case is to provide a block of which a series can be conveniently assembled to interlock with each other and to form transverse interlocking courses or rows, with a view to prevent transverse shifting of the blocks in the roadway even if the roadway is without curbs.

COLORATION PROCESS.—B. D. Avis, Jr., Wallace, W. Va. In the present patent the invention has reference to coloration process, the inventor's more particular purpose being the provision of a simple and inexpensive method of producing iridescent tints and colorations upon glass or upon opaque surfaces requiring comparatively little preparation.

Hardware.

ICE SHAVER.—A. M. Preston, Broxton, Ga. The invention consists of a body formed to receive the shaved ice and carrying a shaving blade and a movable member constituting a lid for the body and operable to force the shaved ice from the body, the latter having preferably a plurality of compartments which are simultaneously filled with the ice.

SHOE POLISHER.—F. Valoux, San Francisco, Cal. The invention relates particularly to that type of polishers adapted to hold and inclose the polishing fabric. An object is to provide a device which will hold the fabric tightly and the stronger the pull on the fabric the tighter will the device grip it.

Heating and Lighting.

GAS IGNITING DEVICE.—W. Gaix, Schöneberg, near Berlin, Germany. The device consists of an igniter proper, such as a platinum pilule, an electric spark former or an incandescent wire, which is carried directly or through the agency of suitable parts by a compensation rod, so that after the gas is ignited the said rod is bent by the heat and moves the igniter out of the zone of hot gases.

Household Utilities.

REFRIGERATOR.—O. M. Campbell, Van Buren, Ark. The purpose here is to provide details of construction of a refrigerator that will render it very convenient, insure proper circulation of cold dry air throughout the interior of the refrigerator, prevent sweaty deposits of moisture on the walls within the refrigerating chamber, and afford perfect drainage for water formed by melting of ice.

RENOVATOR.—J. H. Brown, New York, N. Y. This invention has in view a manually operated device for household use in which the dust and dirt are removed by suction. It consists of two upright wheel-supported frames rigidly connected together at the bottom by a platform and at suitable points thereabove; a receptacle seated on the platform, a nozzle applied to the part to be cleaned, a rotary pump having its inlet connected with the nozzle and discharging into the receptacle, and a driving mechanism for the pump journaled on the frame.

EGG-TESTER.—Evelyn Lewis, Bronxville, N. Y. The invention belongs to that class of testers which consists of a box having openings in the top in which eggs are adapted to be seated in combination with a mirror in the box under the openings for reflecting such light as passes through the eggs, the same being observable through a sight opening located at a point convenient above the mirror.

Machines and Mechanical Devices.

PULP-REFINING ENGINE.—F. W. Quantz, Vincennes, Ind. The main object of the inventor is to provide a shell filling which has the corrugated surface necessary for the reduction of the pulp, but which obviates a former objection, in that all of the pulp is forced into repeated and intimate contact with the revolving plug, thereby rendering the product of uniform texture.

ATTACHMENT FOR LINOTYPE-MACHINES.—A. F. Welling, New York, N. Y. More particularly the invention relates to devices for determining the number of quads to be allowed for a cut, so that the operator will be enabled to assemble the proper number of matrices having intelligible characters to fill the space at one side of the irregular outline of a picture or design and then insert *the proper number of quads or blanks to fill* the remainder of the line.

NURSERY-CHAIR.—P. S. Chandler, Mountpleasant, Tenn. When the chair is set up and the frame is placed in position encircling the chair, the rear ends of the arms are depressed so that the pins engage the enlarged portions of the slots, thus preventing disengagement of the tray from the undercut notches, until the rear ends of the arm are again lifted to disengage the pins.

FRICTION CLUTCH.—M. S. Slagt and T. J. Kelly, Everett, Wash. One purpose here is to provide details for a clutch, which are simple and quick in operation, not liable to slip and that will positively lock together two parts of a machine they are connected with, so that said parts will co-operate or release them instantly when this is essential for the proper operation of the parts connected by the clutch.

GANG EDGER.—D. C. Leonard, Columbia, S. C. The main object of this improvement is to provide a machine which has movable members constituting part of the frame of the device, which can be swung up out of the way to permit easy access to the saws and thereby enable the operator to file them while they are on the arbor.

CALCULATING MACHINE.—C. L. Nelson, Seattle, Wash. This invention relates to improvements in machines of that type in which the keys are operated in accordance with the *number to be listed, and more particularly to* that type disclosed in a previous patent granted to Mr. Nelson, although various features of the present invention might be employed in other calculating machines than that shown in said patent.

PAPER-CUTTING MACHINE.—G. M. Farnham, South Brewer, Me. This invention refers to certain improvements in machines for cutting paper into diagonal strips, and more particularly to that type of machine in which there is employed a cutter disposed at an angle to the roll of paper to be cut, and adjustable to vary the angle at will.

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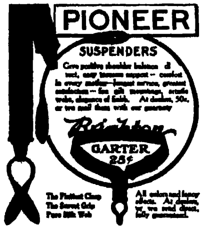

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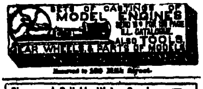

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Valve indicator gate, A. J. Richmond	933,786
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Valve, quick acting safety, C. R. Mills	934,063
Vapor burner, W. Chadsee	933,822, 933,823
Vehicle coupling, A. Weisler	934,250
Vehicle drive gear motor, J. A. Welton	934,117
Vehicle steering gear, R. N. Daniels	934,144
Vehicle wheel, Ingles & Hart	934,178
Vehicle wheel, road, G. S. Ogilvie	934,341
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Window screen, F. C. Ferguson	934,059
Window screen, A. R. Rhoades	934,257
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Wire stretcher, Bradbury & Grubb	934,387
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Yarn drying machine, Allsop & Mason	934,197

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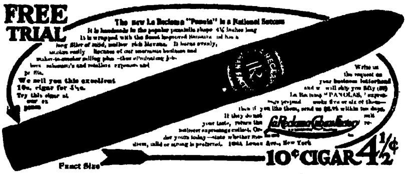

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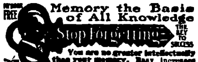

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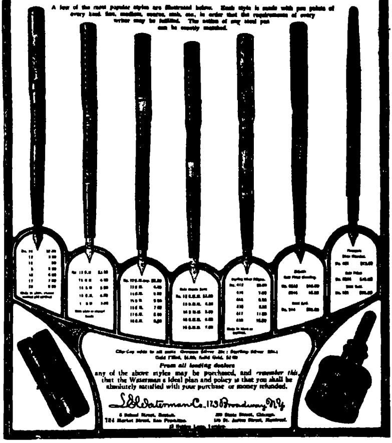

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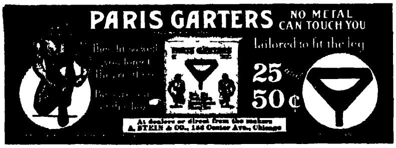

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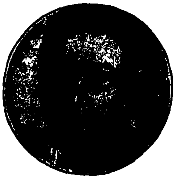

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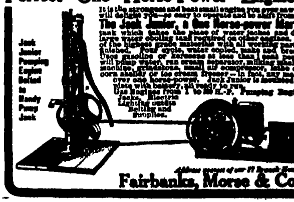

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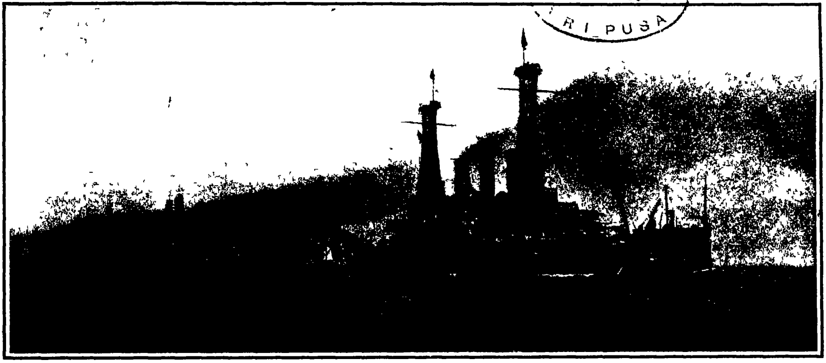

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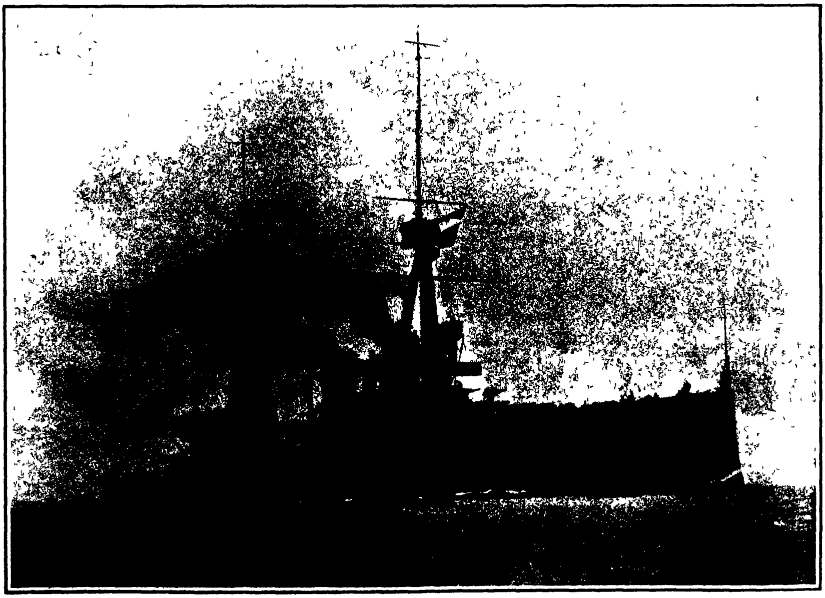

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NEW YORK, SATURDAY, OCTOBER 9th, 1909.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

PHILADELPHIA, THE DELAWARE RIVER, AND JOHN FITCH.

The widespread interest in the early history of the steamboat, which has been aroused by the present splendid tribute to the work of Robert Fulton on the Hudson River, has served to bring into public notice several too-long neglected inventors, prominent among whom is John Fitch. With the exception of a small craft which he tried on the old Collect Pond in this city, the whole of the experimental work of this worthy man was done in Philadelphia and on the Delaware River.

We are free to confess that although we have always associated the name of Fitch with the development of the steamboat, it was not until we began to make a more thorough search of the history of the early inventors that we realized how important a part John Fitch had played in that period, how meritorious was his work, and how practical the degree of success which he attained.

It has been freely admitted that the present festival commemorates merely the inauguration of successful steamboat navigation on the Hudson River, and that the question as to who produced the first practical passenger-carrying steamboat is still an open one. Therefore we suggest, in view of the fact that during three months of the summer and autumn of the year 1790 John Fitch was operating a passenger carrying steamboat on the Delaware, which sailed according to a fixed schedule and was advertised in the daily papers of that day, that it is incumbent on the city of Philadelphia to do justice to the memory of its too-long neglected citizen.

The story of his life and his heroic struggle to design a successful steamboat, as written by his own hand, reposes at present in the Philadelphia Library, to whose care it was committed by Fitch shortly before his tragic death. This unique autobiography consists of five old ciphering books, dog-eared and thumb-worn, whose five hundred pages, covered with the characteristic writing of the author, contain several drawings showing the various steps by which he developed the jet condenser, which played so important a part in driving his successful passenger steamboat of 1790. Regarding the criticism that his method of propulsion by means of a set of reciprocating paddles, arranged in a frame at the stern of the boat, was cumbersome and awkward, we would point out that, before making use of vertical paddles, Fitch investigated the rotating paddle wheel and rejected it on the ground that much of the power of the engine was uselessly expended because of the obliquity of the paddles in entering and leaving the water, the water being alternately forced down and thrown up, with a proportionate loss of propulsive efficiency. On the other hand, argues Fitch, paddles can be made to enter and leave the water in an approximately vertical position, and practically the whole of the power can be used to good effect. Now in this Fitch showed his engineering good sense, and it was not until over half a century later that the feathering paddle wheel was introduced. In this type the floats are hinged at the outer ends of radial arms from a shaft, and by means of an eccentric to which each float is also attached, they are made to enter and leave the water in an approximately perpendicular position, a condition which John Fitch secured by his clumsy but effective reciprocating paddle arrangement. That it was efficient is shown by the fact that he attained on a measured mile, as testified to by several witnesses of high standing in the community, a speed of eight miles an hour, and that he ran his boat regularly between Philadelphia, Trenton, and way points at an average speed of seven miles an hour. This, be it remembered, was from two to three miles better than the best speed of the "Clermont" some twenty years later.

The ultimate failure of John Fitch was due to a lack of influential backing and to a combination of unfortunate accidents. During the winter following his successful season of 1790 he was engaged in the construction of a larger and more powerful vessel called the "Perseverance," which, unfortunately, was torn adrift and wrecked during a heavy storm on the Delaware River. Fitch understood full well the value and significance of his work, and he also realized that if he failed it was not because of any inherent fallacies in his plans, but merely for lack of influence and the necessary financial support. Pitifully prophetic is the following sentence from the diary of this disappointed inventor, who evidently foresaw at that time his early death: "The day will come when some more powerful man will get fame and riches from my invention, but nobody will believe that poor John Fitch can do anything worthy of attention." The remains of Fitch lie in an unmarked grave. The scene of his labors is to-day barren of monument or memorial to bear tribute to his remarkable work.

We commend these facts to the consideration of the citizens of Philadelphia and those towns along the Delaware River which were the scene of his early labors and triumphant but short lived success, in the hope that they may see their way to honor the memory and perpetuate the work of Fitch by some such services and permanent memorials as have marked the present Hudson-Fulton Celebration.

PALESTINE AND SYRIA THE ORIGINAL CEREAL COUNTRIES.

The origin of the cultivation of cereals has seemed lost in the night of time. At the beginning of the historical period, the culture of wheat had extended throughout the ancient world. It was practised in Egypt 4,000 years before the Christian era, and wheat is one of the five plants included in the annual sowing ceremony which the Chinese Emperor Chin-nung instituted 2,900 years before that era. Wheat and barley have also been found, in considerable quantities, in the palafittes or lake dwellings erected on piles in prehistoric times.

Ten years ago the problem of the origin of cereal culture was deemed insoluble, for botanists thought that wheat would never be found growing wild in any part of the world. Subsequently, however, much light has been thrown on the question by the theoretical views of Koernicke, who has reorganized the classification of cultivated varieties of wheat, and especially by the diligent historical researches of Aaronsohn.

Among the specimens of wild barley (*Hordeum spontaneum*) collected in 1855 by Kotschy, at the foot of Mount Hermon, near Damascus, was found a single example of a different grain, the importance of which was ignored at the time. Koernicke observed this plant in 1873, but devoted little attention to it until 1889, when he described it under the name *Triticum vulgare* var *dicoccoides*. He regarded it as the parent of our cultivated varieties of wheat, and his opinion was adopted by Ascherson and Schweinfurth. But this theory was founded on a single plant, which might well have been a plant of cultivated wheat accidentally mixed with the wild barley, for two other botanists had failed to find additional specimens in the same locality. Aaronsohn was equally unsuccessful in 1904, when he went to Mount Hermon in quest of the plant, but in 1906 he found the *Triticum dicoccoides* growing abundantly and in a great variety of forms on Mount Hermon, up to an altitude of 6,000 feet, and at other points in Syria and Palestine. It should be noted that wheat is not cultivated in either of these countries.

The plant is always found associated with wild barley, and grains of wheat and barley have always been found together in lake dwellings and Egyptian ruins, so that our ancestors appear to have cultivated the mixture of barley and wheat with which nature provided them. The Arabs have only one name for the two wild grains.

In 1907 Aaronsohn found a few rye plants in Syria. It is generally supposed that rye is a native of Europe and is, and always has been, unknown in the Orient. In 1908 Aaronsohn found wild barley in the valley of the Dead Sea, and wild wheat (*Triticum dicoccoides*) associated with wild barley on the slopes of Mount Moab and Mount Galaad, in the valley of the Jordan, and on the plateau of Es Salt, always growing in thin soil, parched by the sun, in crevices of limestone and basalt rocks.

HOME-GROWN SUGAR-BEET SEED.

As a result of an experiment which has been conducted near Phoenix, Arizona, it has been found that sugar-beet seed can be grown successfully in that section of the country, and better still, that it can be grown in a single year. In Arizona it is customary to plant sugar-beet seed the latter part of November, harvesting the crop the following July. It has been found that if the seed is planted a month earlier in the fall the beets will produce a crop of seed the following year. This takes sugar beets, for that section of the country, out of the biennial class, and puts them in with the winter annuals. It means the saving of a year in the production of seed, and will greatly simplify the process.

Nearly seven million pounds of sugar-beet seed are used in the United States every year. At present the bulk of this supply comes from Germany, and costs the American grower about ten cents a pound. The German method of producing sugar beet seed is rather complicated. When the beets are dug in the fall a number of the best specimens, averaging in size from 20 to 24 ounces, are selected for "mothers." A sample taken from each of these mothers is analysed for sugar content. In some cases the density and purity of the juice are also determined.

These mothers are divided into grades, according to sugar content, and stored in silos during the winter. Those that fail to come up to the required standard are discarded. In the spring these mother beets are set out and cultivated carefully. From them the seed of commerce is produced. By these painstaking methods the sugar-producing ability of the beets is kept up to its present high standard, and even increased from year to year.

Recently beet seed has been grown to a limited extent in the United States in Utah and Washington. This home-grown seed has shown greater yielding ability than the seed from Germany. The beets from home-grown seed have better quality and higher vitality, and seem better adapted to American conditions. Owing to the difficulty of production, however, beet-seed growing in Washington and Utah has not spread very rapidly.

With more favorable climatic conditions prevailing in Arizona, especially the absence of severe winter weather and the dryness at harvest time, it may be possible to make beet-seed growing an important industry there. Of course, since the beets are not dug in the fall, they cannot be selected as carefully as is done in Germany. Whether the quality of the product can be kept up by other methods of selection remains to be proven. Perhaps some method of breeding like that which is giving such good results in the corn fields of the Mississippi Valley may be adapted to sugar beets. The United States Department of Agriculture has been asked to investigate the matter. The results of this investigation will be awaited with much interest by the people of the sugar-beet growing districts.

THE PLATINUM MARKET.

Platinum is likely to be raised in price, according to the measures which the Russian producers are taking. About 95 per cent of all the platinum in the world comes from the mines at Nijni Taguil and the neighborhood. The mines are now operated by English, German, French, and Russian companies, but there is now a movement in Russia to keep the platinum production in the hands of a native company or a State enterprise, so as to have Russia benefit by the platinum production instead of foreigners. Last spring the aide of the minister of commerce and industry, M. D. Konovaloff, presided at a meeting of the platinum producers, and the assembly came to the following decision in principle, namely, that all the platinum extracted in Russia should be turned over to a State establishment, which would deliver it to a commission charged with the sale of the same, and to be composed of seven members, a delegate of the lesser manufacturers, one from the mean and four from the leading producers who handle more than 800 pounds annually, also a government delegate. This commission will make a reckoning before the end of the fiscal year, and will publish the least price established for the following year. For the first year the price will be 21,000 roubles the pound ($710 per pound) for 83 per cent platinum. Upon the products which are turned over to the State establishments there will be allowed an advance of 80 per cent of the value, at a 5 per cent interest. It will be forbidden to export crude platinum, and the refining must be done in Russia. This decision is not as yet legalized, but it may be done in the future, and it is expected that the price of platinum will be accordingly raised.

A report on the resistance of rivets is presented by M. Ch. Fremont to the Bulletin de la Société d'Encouragement. It is pointed out that the resistance of riveted plates to statical forces or shocks should be borne as much as possible by the adhesion of the plates, and as little as possible by shearing of the rivets themselves, and the author emphasizes the necessity of standardizing the heads of rivets and of regulating the maximum temperature during the process of heating, so as not to destroy the elastic qualities of the rivet. The increased efficiency obtained by the application of continued pressure during the riveting is also mentioned.

[illegible] lost by [illegible] miles, between [illegible], where it passes through salt-carrying districts. The corrosion there is more rapid than over the rest of the route, so that excessive leakage has been caused.

Visitors to Admiral Seymour's flagship the "Inflexible," which is the only vessel of the "Dreadnought" type at the Hudson-Fulton Celebration, will be interested to learn that the new "Dreadnought" cruisers according to the British press are to be much larger and more powerful. They will have a length of 600 feet as against 560 feet, a total horse-power of 60,000 as against 50,000, and twelve 12-inch guns in place of the eight 12-inch carried by the "Inflexible."

There is a certain amount of sentimental interest attaching to the fate of a transatlantic record breaker and it is therefore gratifying to learn that the Cunard Company have arranged to accept $500,000 in settlement of the insurance on the recently burned "Lucania," and reconstruct this famous boat making her thoroughly up to date in the matter of accommodations, etc. The "Lucania" was the first vessel to cross the Atlantic at an average speed of 22 knots.

It is gratifying to note that the large sea-going torpedo boats which are being built for the navy are making, on trial speeds which are greatly in excess of the contract requirement. The "Flusser" built by the Bath Iron Works recently made between 32 and 33 knots on trial and now a sister vessel the "Smith" built by William Cramp & Sons has made 33 knots on trial. Because of their large displacement of 700 tons these high speeds on trial mean much more than the high speeds achieved with our earlier boats, which have never approached in average day by day service the record made on their trial trips.

At the naval depot at Horton Norway the Norwegian government is refitting Nansen's old Arctic vessel, the "Fram" for another trip to the Arctic. A new gasoline engine capable of driving the vessel at four or five miles an hour is being installed and a thorough overhaul is taking place. In a recent letter to the Norwegian consul at San Francisco Capt Amundsen states that he expects to leave San Francisco next June for the Behring Sea where he will allow his vessel to be frozen into the ice and be carried by way of the Pole toward the northern part of Greenland. The "Fram" is about three times the size of the "Gjoa" now in the Golden Gate Park San Francisco in which Amundsen recently made his famous northwest passage.

Notice was recently given to the Treasury Department at Washington by the Pennsylvania Railroad Company that it proposes to operate its trains into the new station on the first day of December. In the great terminal between Seventh and Eighth Avenues and 31st and 33rd Streets there are sixteen miles of track including twenty-one standing stations. Two tunnels connect the station with New Jersey and four with Long Island. Started in 1902 work has been carried on continuously ever since and when the scheme is fully completed it will have cost over $90,000,000.

It will be remembered that at the opening of the Alaska Yukon Exposition at Seattle the Great Northern Railway put on a 60-hour train from Chicago to Puget Sound. With the completion of the new Milwaukee, Chicago & St. Paul extension the Maintenance of Way Department will bend their efforts to bringing the new track into such high-class condition as to permit of the running of high-speed through expresses from Chicago to the coast. The Milwaukee managers expect that next spring they will be in a position to offer a 54-hour schedule from Chicago to Seattle. This, coupled with the 18 hour service from New York to Chicago, will bring the time between New York and the coast down to three days.

The greatest possible interest attaches to the announcement that Mr George Westinghouse, Rear Admiral Melville, and Mr John MacAlpine have devised and built a reduction gear for interpolation between the steam turbine shaft and the propeller shaft for turbine-driven marine engines. The necessity for reducing the economical speed of the turbine to the economical speed of the propeller has long been manifest, and as we stated editorially last week, considerable effort has been directed to this problem. The helical spur gear has been in use for many years on the De Laval turbines, but in the present device, by an ingenious construction of an automatically adjustable bearing it has become possible to apply this gear so as to transmit 6000 horse-power, at 1,500 revolutions of the pinion per minute, at a reduction ratio of 5 to 1. It is claimed by Mr. Westinghouse that using this reduction gear, and with an inconsiderable loss from friction, it would be possible to apply the 6,000 horse-power at the "economical" [illegible] with a reduction [illegible] of the turbine [illegible]

AERONAUTICS.

Orville Wright, on September 30th, made another record for height while flying before the Empress of Germany and other members of the royal family at Potsdam. On this occasion according to cable reports, he reached a height of 275 meters (902 feet). This is over 50 feet higher than his previous record made only a week before.

In connection with Berlin's aviation week Hubert Latham made some excellent and startling flights recently. On the 25th ultimo he made a 20-minute flight above Tempelhofer field. The flight was terminated because of heavy rain. Two days later he made the most daring flight up to date when in 24 minutes he flew from Tempelhofer field across Berlin to Johannisthal, where the aviation meeting was being conducted. The flight was made at a height of about 300 feet, the distance of 11¼ miles plus two circuits of the field (2.1 miles) upon his arrival being covered in 24 minutes.

Besides the exhibition of Curtiss's 60-horse-power biplane in Wanamaker's store in New York last week another of these machines fitted with a 30-horse-power 4-cylinder motor was exhibited at the aeronautic show in Madison Square Garden. There were also two other similar biplanes but one of which was fitted with a motor however and had made a short flight. The Braunier & Smith biplane resembled both the Wright and the Curtiss. It had the twin vertical rudders of the former and the single-surface horizontal rudder of the latter. C & A Witterman exhibited a strong well built biplane glider that attracted considerable attention. Several other gliders were shown as well as numerous models, samples of balloon and aeroplane cloth, aeroplane parts, etc.

On October 1st, at the Berlin aviation meeting Rougier with a Voisin biplane made an excellent endurance flight in which he remained aloft 2 hours 41 minutes and 50 seconds. Making 52 circuits of the field, he covered an official measured distance of 130 kilometers (80¾ miles) at an average speed of 30 miles an hour. Probably he actually covered over 90 miles in view of the many turns. The flight was only terminated because of approaching darkness. While Rougier's official record does not beat Farman's it is encouraging as showing that a gasoline motor can be made to run for a long time on an aeroplane as well as on an automobile. The same day Farman flew 1 hour and 32 minutes covering 82½ kilometers (51.28 miles) at an average speed of 33.41 miles an hour. Baron de Caters flew 18.6 miles in 34 minutes.

Just after we had gone to press with our last issue, which contained an article upon aeronautic accidents the worst disaster of modern times occurred in France. Owing to the breaking of a propeller blade (which was projected clear through the balloon envelope) the new military dirigible "République" was almost instantly deflated causing it to fall to the ground from a height of 500 feet. The four officers who formed the crew were all killed almost instantly. This disaster gives a strong argument in favor of the rigid frame compartment dirigible of Count Zeppelin which it will be remembered successfully went through a similar accident a few weeks ago. In this connection it is interesting to note that Wilbur R. Kimball had on exhibition at the preliminary aeronautic show last week in Madison Square Garden New York a model of a non-rigid dirigible which had a ring of small propellers completely surrounding it. He argues that small light wood propellers can be run at high speed without danger of breakage, while a greater thrust per horse-power is also attainable.

Owing to rainy and windy weather the aeroplane flights of Wilbur Wright and Glenn Curtiss from Governor's Island up the Hudson River to Grant's Tomb and back did not take place last week as scheduled. Up to Saturday noon the only flights that had been made were a short half-mile jump by Curtiss shortly after 7 A. M. last Wednesday and three practice flights by Wilbur Wright the same day. Two of these were made at 8.56 and 10.16 A. M. and were of 5 minutes 27 seconds and 6 minutes 33 seconds duration respectively. They were made in a strong westerly wind of about 20 miles an hour velocity. The first one consisted of the circling several times of the island, the machine flying most of the time at a height of 50 feet above the water. The second flight was much more sensational for after circling Governor's Island as before Mr Wright flew over to Bedloe's Island and around Bartholdi's famous Statue of Liberty. After making all his great records in France it was particularly fitting that Wilbur Wright, in his first great public flight in America, should pay a visit to France's gift to her sister republic. These two flights, as well as the third one of 2 minutes 41 seconds duration, which was made at 5.25 P. M. in what was, if anything an even stronger breeze gave an excellent demonstration of Wright's ability to fly in a strong wind. It is probable that as soon as a reasonably calm day occurs he will make a record flight that will remain unbeaten for some time.

SCIENCE.

The United States Department of Agriculture is investigating the various methods of preserving eggs, for the purpose of determining which method is most efficacious and works least injury to the eggs. It has been discovered that the amount of moisture in the air surrounding the egg is an important factor in egg preservation, for which reason the Department is conducting experiments to devise a means for regulating the amount of air supplied to eggs kept in cold storage.

Col. Kosloff's Mongolian expedition equipped by the Russian Geographical Society has returned after twenty months of exploration in the region of the Andos Mountain range in Tibet. The chief discovery made was of the ancient city of Kharakhoto called by the Chinese Siansin, which the Manchurians destroyed more than 500 years ago. The explorers found a great quantity of relics used in Buddha worship, a metal figure of Buddha perfectly preserved and perfectly preserved manuscripts on canvas and silk in the Chinese, Manchurian and Tibetan languages.

F. Fritz has discovered that the domestic cat possesses a peculiar organ of sense consisting of a few long and stiff bristles or feelers which spring from a region of the skin richly furnished with nerves in the vicinity of the wrist joint of the fore leg. These organs called carpal vibrissæ had previously been found in numerous animals including rodents, edentata, carnivora, the lower quadrumana and *Hyrax*. They are found chiefly in animals which hold their food with their forepaws or which crawl and climb. Thus they are wanting in the ungulata with the exception of *Hyrax* and also in the apes and monkeys which possess in their fingers and palms much more delicate tactile and prehensile organs. It is remarkable that they are also wanting in the dog in which animal Fritz has sought them in vain.

The Académie des Sciences recently awarded a number of prizes for scientific work. In mechanics M. Lecornu, professor at the Polytechnic College received the Montyon prize $140. M. de Sparre the Poncelet prize $400. M. Boulanger the Boileau prize of $260. In astronomy the Lalande prize of $108 was awarded to M. Borelly of Marseilles. For navigation the grand prize of the marine $1,200 was divided among Messrs Colin, Jeance, Marber, Doyère, Lecocq, Timot and Fromaget. The Plumey prize of $800 was awarded to Messrs Routier and Caralp. In mineralogy and geology the Raulin prize of $30 was given to M. Leon Bertrand and the Labbé prize of $200 to G. Rolland. Prof Mercadier of the Polytechnic College received the Pierson Perrin prize of $10,000. The Delesse geological prize of $280 was awarded to Prof Glangeaud of Clermont. In medicine a number of prizes were awarded among which was the sum of $800 given by the academy itself to Dr Haffkine for his work on vaccination for cholera and bubonic pest. The academy also distributed the second annuity of $[illegible] coming from the Bonaparte fund among different workers in the scientific field.

A letter has been received at Harvard College Observatory from Prof. C. C. Comstock, Director of the Washburn Observatory, giving the following finding ephemeris of Halley's comet derived by him:

Perihelion Passing April 18th

Paris M. T. 1909	D	R. A. H	R. A. M	Dec. Deg	Dec. M	Mag
September	22	6	19 3	+17	7	15 1
	27	6	18 8	17		
October	2 5	6	17 8	17	3	14 8
	7 5	6	16 0	17	1	
	12 5	6	13 4	16	[illegible]	14 5
	17 5	6	9 8	16	8	
	2[illegible] 5	6	4 9	16	6	14 1
	27		58 9	1[illegible]	4	
November	1 5	5	51 3	16	[illegible]	1[illegible] 8
	6 5	5	42 1	16		
	11.5		30 8	+16	47	13 4

The above ephemeris is derived from that of Holetschek Astro. Nach. 4330 by interpolating the time of perihelion passage so as to satisfy observations made by Burnham and Barnard September 15th and September 17th respectively.

A letter has been received at this observatory from Prof. E. B. Frost, director of the Yerkes Observatory, stating that Halley's comet was observed visually by Prof. E. E. Barnard on September 24 d. 20 h. 24 m. 21 s. G. M. T. in

App. R. A. 6 h. 18 m. 56.72 s.

App. Dec. +17 deg. 6 m. 11.2 s.

Comet followed comp. star 0 m. 19.03 s. by 8 direct measures.

Comet north of comp. star 0 m. 39.4 s. by 9 direct measures.

The comparison star was Berlin A. G. 2122.

The comet was considerably brighter than on the 17th, estimated as 15th mag., measured diameter 11 s., indefinite condensation almost amounting to a small nucleus, no definite boundary."

STEREOSCOPIC MOVING PICTURES IN NATURAL COLORS

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN

During the past few months several devices have been perfected for producing moving pictures in their natural tints all carried out upon the same lines All suffer from the same disadvantage—the color rendition upon the white screen is imperfect and untrue Mr William Friese Greene F R A S F R M S exhibited in London as far back as 1898 a series of animated natural color pictures The system which he duly patented was to revolve a disk of glass divided into three equal sized sectors each representing one of the three fundamental colors and revolving it in front of the lens as the exposures were being made each section of the sensitized film (corresponding with the size of the ordinary cinematographic picture) being exposed through one of the three color filters In making the subsequent projection the colored disk was again revolved in such a manner that the same relationship of picture to color filter that prevailed during the exposure of the negative was repeated The rays of light consequently passed through the black and white film and thence through the color filter The resultant picture was projected in accordance with the well known phenomenon of visual persistence producing the impression of a complete three-color image

The demonstration aroused considerable interest but the inventor soon realized that such a system possessed one serious disadvantage The glass disk had necessarily to be of a certain thickness—from one sixteenth to one twelfth of an inch—so that there was a certain depth of transparent glass through which the light rays had to pass before or after reaching the color filter depending on whether the color side of the disk was next to the transparent film or reverse This fact produced disturbances in light refraction and reflection, of such a severe character that the projected image as seen upon the white sheet was a color distortion and a crude reproduction of nature The extent of the deflection of the light rays in passing through the transparent thickness of the glass disk varied considerably and in the resultant picture occurred an undue predominance of one or two colors, which completely destroyed the natural effect. It is this system which is now being developed by various experiments in the field of chromo-photography, but which the original inventor abandoned for the foregoing reasons.

By continuing his experiments Mr Friese-Greene was enabled to overcome all the incidental difficulties inherent in his first apparatus. He abandoned the revolving glass disk and resorted to a prism placed in front of the lens This yielded a much more satisfactory result but was naturally somewhat primitive and commercially impracticable Recently, however he has completed and patented an entirely new system, which together with many other important improvements he has effected in connection with the apparatus itself (both camera and projector) and also in the preparation of the sensitized films promises to improve chromo-photography

Through the courtesy of the inventor the writer was afforded an opportunity of examining the apparatus and the whole process of taking and projecting films by this new system for the SCIENTIFIC AMERICAN while the accompanying illustrations, specially taken for these pages serve to show the camera and its method of operation At the time of writing some twenty films had been secured depicting varying scenes in natural life from incidents in busy streets to studies of insects and growing flowers Not only are the color effects obtained, but they are stereoscopically projected The effect produced upon the screen is precisely the same as that obtained with ordinary stereoscopic photographs when observed through the hand instrument devised by Oliver Wendell Holmes.

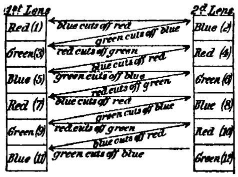
With this apparatus moreover, a continuous picture is obtained, which is not the case in the ordinary machine. In the latter instance as is well known the

(Continued on page 259)

Fig. 4 —Front view of stereo-chromo-cinematograph projector, showing how the twin lenses are alternately exposed by the shutter

Fig 5.—A three-quarter view of the stereo-chromo-cinematograph, showing the mechanism for carrying the endless color band.

DIAGRAM SHOWING METHOD OF WORKING COLOR FILMS OF TWO LENSES ALTERNATELY IN FRIESE-GREENE'S CHROMO-CINEMATOGRAPH



Red (1) in first lens is exposed followed by Blue (2) second lens
Green (3) " " " " " Red (4) "
Blue (5) " " " " Green (6) "
Red (7) " " " " Blue (8) " "
Green (9) " " " " " Red (10) "
Blue (11) " " " " " Green (12) " "

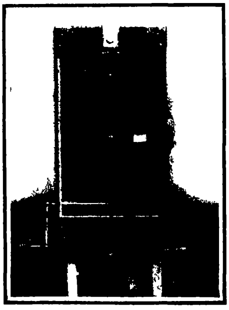


Fig 1 —The face of the camera with lenses removed.

The shutter exposes one lens while the other is closed to bring a fresh section of film and its relative color filter before the lens aperture. In the aperture shown open, the blue filter may be seen.

Fig. 3.—Interior of one side of the camera.

Showing system and mechanism for operating the endless band of color filters and how it is brought into juxtaposition with the sensitized film before exposure and separated therefrom after exposure.

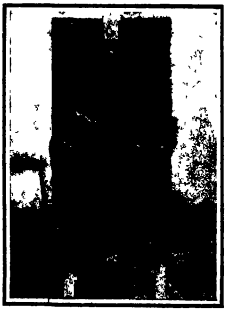


Fig. 2 —Face of the machine, showing twin lenses for securing stereoscopic effects.

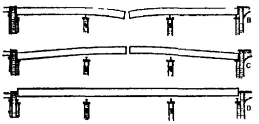
The handle at the left drives the photographing mechanism, while on the right the sighting device is shown closed.

STEREOSCOPIC MOVING PICTURES IN NATURAL COLORS.

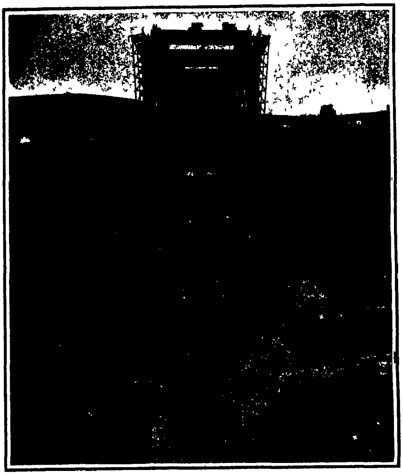
ERECTION OF THE FADES VIADUCT

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN

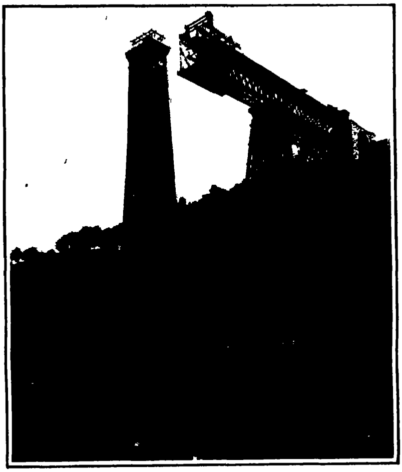
A piece of bridge construction work presenting some noteworthy features has recently been carried out in France. It is known as the Fades Viaduct and is designed to take the railroad across the wide valley in which flows the river Sioule The present work is notable for two reasons, one of these being the exceptional height of the masonry pillars, which are built in the valley, and in the second place for the considerable length of the central span The viaduct has the form of a straight iron lattice-work bridge construction. It is carried upon two lofty piers and two abutments the length of the consecutive spans being 383 feet 475 feet and 383 feet. The flooring of the viaduct lies at a height of nearly 440 feet above the level of the Sioule The height of the great masonry columns of rectangular section is 304 feet and they appear to be the highest pillars for a bridge built in Europe up to the present The whole undertaking reflects great credit upon the constructors the well known Cail Company and the work was carried on under the general direction of its chief M Le Chatelier from whom we have obtained the following points The most difficult part of the work was to make the junction between the overhanging halves of the central span This was carried out on the 18th of May last and the operation was performed with remarkable precision To make the junction the whole bridge had to be lifted off the two main columns by hydraulic jacks in order to make up for the slight sinking of the two fore ends and bring these exactly opposite each other and in true line After joining the ends the bridge was lowered again upon its supports The present viaduct lies upon the railroad which runs in the southeastern part of France in the region of Clermont Ferrand and is built upon the section which runs between Saint Eloy and Pauniat On each side of the 475 foot central span there is a side span of 383 feet In the rear of the stone abutments there is an approach to the main structure consisting of a small masonry arch of 46 feet span on one side and at the other end is built a 162 foot truss span The two main stone piers sup-



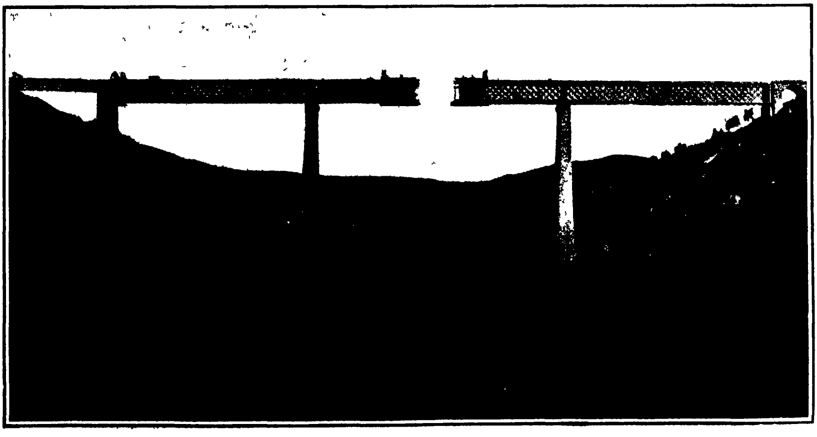
B. Ends overhanging at the buttresses C Lifting off the pillar end jacks and lowering D Lifting at the buttresses and joining ends



End view of the truss



Method of construction on end spans



The meeting ends of the truss in the central span.

ERECTION OF THE FADES VIADUCT.

porting the central span of the viaduct are built to a height of 404 feet above their foundations. These latter are carried down to a depth of 40 feet for the pier lying on the left bank, which makes the total height of the stone work to be 344 feet. For the foundation on the other bank the depth is somewhat smaller making the total height of the pillar to be 312 feet The bridge is constructed for single track standard gage, and is built of a rectangular cross section consisting of two main side lattice trusses 38 feet deep, which are spaced 22 feet between centers. Upon the top are laid the floor beams which serve to support the stringers, and upon those rest the rails of the track The sway bracing is spaced at intervals of 48 feet. In order to allow for expansion and contraction, the structure is fixed at one of the abutments only while upon the two main pillars and the other abutment it is mounted upon a movable support of the usual kind.

In constructing the bridge it was not found possible to use the method which consists in building the spans on the ground back of the site and then driving them forward into place seeing that there was not the available space for carrying this out. Another method, therefore, had to be employed, and it consisted in the use of a scaffolding which is mounted under the side spans. The bridge was built from the abutments to the end of the scaffolding and from this point it was built across on the overhanging principle until it reached the main piers, falsework being used below the first half of the span One of the characteristic features of the work is the erecting of the bridge in the overhanging portions In order to carry this out there was used a cage-like traveler, which ran along upon the outside and surrounding the truss It traveled upon rails which were laid upon the top of the truss and upon the two sets of rollers. Measured from the flooring and from the back end of the cage the first roller lies at 13 feet and the second at 40 feet distance, representing the end point of the truss, but the fore part of the cage projected out from the finished end of the truss with an overhang of 33 feet. On the inside of the truss there was a corresponding structure built of timber Upon it were three working platforms, arranged to give access to the different heights. Supported from the inner timber structure and also from the outer cage there were hanging platforms which were let down by pulleys, for the workmen who operated the compressed air riveters These latter were hung down at the level of the platforms by traveling carriages, which ran upon upper rails at the top of the cage. On the top was also mounted a large traveling erecting crane designed to take the beams and other material from the back end and bring it forward to the working point. In this way the work advanced at the average rate of 3 feet per day The trusses were thus brought forward to the main piers at each side They were built forward in the same way to form the middle span When the halves of the middle span met they deflected below the normal position, and it was necessary to lift them to their true level The operation was carried out by raising the trusses off the piers by hydraulic jacks, and at the same time lowering them at the abutments, thus tilting up the spans as a whole and allowing the ends to match at the middle. Upon the piers where the weight was 1 200 tons, there were used for the lifting four hydraulic jacks of 300 tons each. The base of the jacks rested upon a set of rollers, so as to give the needed movements. A small 8-ton hydraulic jack gave the lateral movements which were required In this way the two trusses were raised and brought into exactly the proper position at the meeting point. When this was done the chords were joined by temporary bolts at first, so as to complete the truss from end to end, making a continuous structure The bridge was then raised at the abutments and finally lowered into place upon the pillars, so as to bring it to its normal position.

German-American Patent Treaty.

The American Association of Commerce and Trade in Berlin issues the following announcement prepared by Henry Schmidt, on the effect of the new patent treaty between this country and Germany

The new patent treaty between the United States and Germany which went into effect on August 1, places American citizens on a decidedly better footing in regard to the utilization of patent protection in Germany as it frees them from the obligation to work their patented inventions in Germany within three years from the granting of the German patent. Heretofore any failure to comply with this working obligation would in the case of an action for revocation of the patent being brought against the patentee result in the loss to him of his German patent.

This is no longer to be the case with the German patents of United States citizens, as the new treaty provides that the working of a patent in the territory of one of the contracting parties shall be considered as equivalent to its working in the territory of the other party Hence an American citizen who works his United States patent in the United States will no longer be required to work his corresponding German patent in Germany in order to avoid loss of his German patent in case of an action for revocation being brought against him.

The question as to whether the provisions of the treaty are to apply also to existing German patents in regard to which the three-year term allowed for working already expired before the date on which the treaty went into effect, is not decided yet, but many persons are of the opinion that even such patents will now be entitled to the benefits of the treaty, provided that no action for revocation was actually entered prior to that date. At any rate, it may be assumed that, in addition to all German patents applied for after that date, such older patents in regard to which the three-year term extends beyond that date will enjoy the benefits of the treaty.

This new treaty, abolishing, as it does, a condition of affairs that has been felt as a hardship by American inventors, will no doubt induce many American inventors to apply for German patents in cases in which they would otherwise have abstained from so doing.

Electricity and Vegetation in Polar Regions.

Electroculture is an old subject, upon which opinions are still at variance. Some investigators have definitely rejected the hypothesis that vegetation is affected by atmospheric electricity On the other hand, Prof Lemstroem of the University of Helsingfors, Finland vigorously sustains this theory and adduces experimental evidence in its support. Lemstroem asserts that when plants cultivated in the polar regions escape destruction by nocturnal frosts, they grow far more rapidly and luxuriantly than plants growing in milder climates. Rye, barley, and oats, especially, yield very large crops, in spite of primitive methods of cultivation with wooden plows and harrows. The growth of plants depends not only on the fertility of the soil, but also on the supply of heat, light, and moisture In the polar regions the supply of heat is very small The rapid growth of plants in these regions has hitherto been attributed to the continuous daylight of two or three months in summer, but this explanation must be abandoned, since it has been proved that, even in those months, less heat and light are received from the sun in the polar regions than at the latitude of 60 degrees. Lemstroem finds several reasons for believing that the cause of rapid growth in the Arctic is to be found in the electrical currents which flow between the earth and the atmosphere and produce the phenomena of the aurora borealis The pointed leaves of conifers and the barbs of ears of grain facilitate the transmission of these currents through those plants, and this function supplies a reason for the existence of these peculiarities.

From a study of the concentric annual layers of growth of conifers growing in various latitudes, between the 60th and 67th parallels, Lemstroem finds that the thickness of the annual layer varies according to a definite law, showing maxima and minima which indicate a period of ten or eleven years, coinciding with the period of sun spots and auroras. The differences, furthermore, are greater in the great firs within the Arctic circle, at 67 degrees north latitude, than in trees growing further south This appears to indicate that the atmospheric electricity of the polar regions exerts a beneficial effect upon vegetation

Lemstroem has also made experiments on the effect of electricity, produced by a Holtz machine, upon barley, wheat, and rye, growing in pots and in the open ground The results of these experiments appear to him to give support to his theory of the favorable influence of electricity upon the growth of plants.—Cosmos.

The Current Supplement.

The opening article of the current SUPPLEMENT, No. 1762, discusses in a most interesting manner the caisson method of sinking the Detroit River tunnel. Excellent illustrations accompany the article. "Platinizing or Platinum Plating" is the title of an article which gives some very interesting technological information. The comparison of the phonograph and photograph by Dr R. Defregger in an article entitled "The Analytic Eye and the Synthetic Ear" illustrates the contrasts between the senses of sight and hearing. Our impression of the universe, as the article points out, would be curiously different if the functions of these two senses were interchanged, so that the ear would perform the work of analysis and the eye the work of synthesis Thomas W. Relph discusses the different practices of illumination. He points out that in the field of illumination practice is several thousand years old, while theory is only beginning to be developed. He gives also helpful suggestions as to proper illuminations for various types of interiors. A résumé of some recent processes for the fixation of atmospheric nitrogen is presented. L. Zehnder writes on the dangers of atmospheric electricity in aeronautics. A telephone system for Peking is described. G. Millochau of the Paris Observatory discusses the subject of stellar evolution and the origin of worlds. "How water and [illegible] out by F. [illegible]. The great megalithic structures of the later stone age were necessarily erected without the employment of any more elaborate machinery than levers and rollers from trunks of trees. A discussion of the wonderful monuments thus erected is presented. Dr. George M. Gould's paper on the rôle of visual function in animal and human evolution is published.

The Highest Balloon Ascension in America.

Although a large number of *ballons-sondes* were dispatched from St. Louis in 1904-7 under the direction of the writer, none had been employed in the eastern States until last year. In May and July, 1908, four *ballons-sondes* were launched from Pittsfield, Mass., with special precautions to limit the time they remained in the air and so prevent them from drifting out to sea with the upper westerly wind. Three of the registering instruments have been returned to the Blue Hill Observatory with good records. The first instrument sent up on May 7th was not found for ten months and the record, forming the subject of the present article, is very interesting because it gives complete temperature data from the ground up to 17,700 meters, or 11 miles. This is 650 meters higher than the highest ascension from St. Louis, which, by a coincidence, was also the first one to be made there. On May 7th a general storm prevailed, so that the balloon, traveling from the east, was soon lost in the cloud and its subsequent drift could not be followed, but the resultant course was 59 miles from the southwest, as determined by the place where the instrument fell two hours later At the ground the temperature was 4.5 deg. C., and this decreased as the balloon rose to the base of the cloud, which itself was considerably warmer than the underlying air. Above the cloud the temperature continued to fall with increasing rapidity up to a height of 12,500 meters (nearly eight miles) where the minimum of —54.5 deg. C was registered. Here the great warm stratum was entered and penetrated farther than ever before in this country, namely, to the height of 17,700 meters, where the temperature was —45 6 deg. C. An increase of 10 deg occurred, however, in the first 3,000 meters, for above 15,500 meters nearly isothermal conditions prevailed, confirming the belief of Teisserenc de Bort that what he calls the "stratosphere" is composed of a lower inverting layer with isothermal conditions above extending to an unknown height. In an ascension last November in Belgium the relatively warm stratum was found to extend from 12 900 meters to the enormous height of 29,000 meters, or 18 miles, where there was still no indication of its diminution.—A. Lawrence Rotch in Science.

Glass Espalier Walls.

When vines and trees are trained in espaliers on the south side of a wall, the north face of the wall is usually wasted, although it can be used for the cultivation of varieties of apples, pears, and cherries which are hardy and not subject to rot. If a transparent wall could be used, plants growing on both sides of it would receive the benefit of the sun's rays. Some experiments have been made with glass walls. Count de Choiseul recently published the results of such an experiment, with photographs showing heavily fruited pear trees on both sides of the transparent wall The wall, which is about 60 feet long and 6½ feet high, was erected in 1901. Each side of it was planted with 15 pear trees of the variety *Doyenne d'hiver* (Winter Doyen), giving a wall area of 232 square feet to each tree. In 1907 the trees on the south side bore 134 pears, weighing 91 pounds, and the trees on the north side bore 109 pears, weighing 77 pounds. All the pears were of very fine appearance and without blemish, and the pears from the north side were smoother than the others.

In the nursery of Croux et Fils is a glass wall, which is surmounted by horizontal glass sashes and planted with the same varieties of peaches, apples, and pears on each side. These espaliers also began bearing in 1907, and both sides have produced equally fine fruit. The difference in temperature between the sides of the wall is not very great, as the southern face reflects less heat and is therefore cooler than that of a masonry wall, while the northern side is warmed by the rays which pass through the glass. A masonry wall possesses, theoretically, one advantage over a glass wall, as it absorbs during the day a greater quantity of heat, and consequently exerts a greater heating effect at night. Longer experience will be required to determine which material is the better on the whole. The cost of construction is practically the same for both.—Cosmos.

A rust-preventing coating for iron, used by a [illegible] manufacturing company, consists in covering iron and steelware first with lead, then electrolytically with zinc, and finally heating the coating so as to [illegible] an alloy of the two metals which has the [illegible]

Correspondence.

LATHER AS A TRAP FOR INSECTS.

To the Editor of the SCIENTIFIC AMERICAN

Here is a little experience that may be valuable to others:

An hour ago, while I was reading my SCIENTIFIC AMERICAN, my room was invaded by a swarm of gnats, and I was unable to continue my reading. Just as I was wishing I had sticky flypaper, I thought of something else. I took a cake of toilet soap and made a quantity of stiff lather, and spread it on some sheets of paper which I laid in the bright light under my lamp. I also covered the top of the lamp around the burner with the lather In fifteen minutes every gnat had got tangled in the lather, besides a candle moth or two for good measure As I was reading your paper at the time I thought it might be useful to you, so here you have it. L. L. KLINEFELTER.

Obar (formerly Perry), N M.

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THE POPE AND THE COMET

To the Editor of the SCIENTIFIC AMERICAN

I regret that you have published the old fable of the Pope and the Comet. Kindly correct it in the name of truth. (Rev) H S SPALDING, S J

Chicago, Ill.

In an article published in Popular Astronomy last October, William F Rigge considers this subject He writes

"It seems that no article can be written on Halley's comet without bringing in the oft-told story of the bull which Pope Callixtus III so ineffectually launched against it, or of the Angelus bells which were rung to frighten it away, or of the prayers which were to deliver the Christian world from the devil, the Turk, and the comet. The truth-loving reader will therefore, be probably most intensely surprised when he hears that, as an actual fact of sober history there is no truth whatever in the story, not even in its least details. And the proof is easy and solid.

"First. While Newcomb calls the bull a myth, but along with the Columbian and Chambers encyclopedias believes that prayers were ordered to be said against the comet, no allusion whatever to the Pope, the bells and the prayers is made by Sir John Herschel, Grant, Young, Comstock, Todd, Langley, the American Cyclopedia, the Encyclopedia Americana, the Encyclopædia Britannica of 1902, etc While this may be a negative argument, it is not, however, an inconclusive one for why should these eminent authorities, all of them non-catholic, not mention the story if it is true, when so many other writers speak of it?

"Second. The Bullarium Romanum is a large series of volumes containing in Latin most of the official documents ever issued by the popes, from St. Peter down to our own day. Owing to the definiteness of the reference and the short reign of Callixtus III, it was an easy task for me to read all the documents of this pope, and I can attest from my own personal knowledge that not only is there no bull against or concerning a comet, there is not even a paragraph, nor a phrase, nor a word, which might be construed to refer to a comet.

"Third. The story is so universally told and is to be found in so many writers, such as Arago, Draper, Babinet, Guillemin, White of Cornell, etc., that most persons are really excusable when they are misled into the conviction of its truth, and then simply copy it and pass it on to the next generation If the reader of these lines is really interested in the matter, I would refer him to an able article entitled "Of a Bull and a Comet" written by John Gerard, S J, and published in The Month, London, in February, 1907 Here the whole story is traced to its fountain head, and it is shown by the best authorities, nearly all of them non-catholic, that not only no bull was ever launched against the comet, but prayers were not even ordered to be said against it, although the prevailing opinion of the scientific men of the time was that the comet foreboded calamity to the earth Any one that wishes it may obtain a free reprint of the article in question by applying to the Superintendent of Parish Schools, Broad and Vine Streets, Philadelphia.

"Fourth. The article just referred to traces the origin of the whole story about the bull against the comet to this one paragraph of Platina, in his Vitae Pontificum, published in Venice in 1479 As this writer was not only in Rome at the time, but was also archivist of the Vatican when he wrote his history, his authority ought to be of the utmost value. These are his exact words:

"'A hairy and fiery comet having then made its appearance for several days, as the mathematicians declared that there would follow a grievous pestilence, dearth, and some great calamity, Callixtus—to avert the wrath of God—ordered supplications, that if evils were impending for the human race, He would turn all upon the Turks, the enemies of the Christian name He likewise ordered, to move God by continual entreaty, that notice should be given by the bells to all the faithful, at midday, to aid by their prayers those engaged in battle with the Turk.'

"Let us read the words again and study them carefully 1. The Pope did not issue a bull against the comet, he ordered supplications 2 He ordered these conditionally 'that if evils were impending,' prudently neither admitting nor rejecting the authority of the mathematicians who declared that pestilence, dearth and some great calamity would follow the appearance of the comet. 3. He assumes no authority over the comet nor bids it be gone he orders supplications, declaring himself to be a suppliant, that if evils were impending, God would turn them upon the enemies of the Christian name. 4 Bells are to be rung to remind the faithful to pray, not to frighten away the comet.

"This one quotation *from one* author, which has been the germ of the whole comet story, weakened as it is by our simple analysis, becomes of no value whatever when we apply the rules of ordinary historical criticism. We have only the word of Platina that the Pope ordered supplications to be made and bells to be rung, he neither refers to any papal document nor does he quote the Pope's exact words. Now, as the Bullarium Romanum contains all the official documents of all the popes, and as not one of the declarations of Callixtus III alludes in any manner whatever, directly or indirectly to a comet, we have every reason to dismiss the testimony of Platina altogether For this same reason we must also reject the testimony of each and every writer that mentions the comet story or any of its details, because not a single one of them has ever given the slightest reference to any official document ever promulgated by Callixtus III whether in the Bullarium Romanum or out of it, nor supported his assertion by anything stronger than a quotation from a previous writer who was equally deficient in his historical *proofs*

"There is, therefore, no foundation whatever for the *story* that Callixtus III issued a bull against or concerning a comet, that he ordered bells to be rung to frighten it away, and that he ordered prayers to be said to deliver the world from its influence '

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THE NUMBER OF OUR ANCESTORS.

To the Editor of the SCIENTIFIC AMERICAN

If all of one's progenitors had been totally unrelated, each generation back would consist of twice as many persons as the one preceding it. But the true number of one's ancestors would in a few generations cease to even approximate the figures thus obtained

It is likely that after going back just a few generations, the number of ancestors in each degree would remain fairly constant. In many instances of small isolated communities it is possible that the eighth to tenth remove might include the entire community at that time From that point, the number would bear a definite relation to the population, and would often be a decreasing factor

It may be inferred from the persistence of some strongly developed types, that persons of the same ancestry are drawn together by natural selection without any knowledge of their common parentage, as most people's knowledge of their own genealogy becomes hazy when the third generation is passed In fact, it generally ends there There is not one person in a thousand that can name all his great-grandparents

It seems to me the probabilities are that when a generation includes as many as one thousand persons, that number is not likely to be exceeded by any previous generation, and I do not believe that number would be reached ordinarily in less than twenty generations.

The tenth-degree ancestors would number 1 024 if there were no deductions by reason of plural lines of descent from some of them

F W A shows that the second third, and fourth degree ancestors may number only four each Blackstone in his Commentaries on English Law using a very similar illustration, shows that an indefinite number of generations might consist of but four persons each and that *all the unions might still be legal* Twenty generations of legal ancestors might then comprise only seventy-eight persons, and it *seems probable* that this number is nearer the truth than the enormous *number* suggested by the first contributor

The theoretical number of ancestors in ten generations would be 2,046, but suppose that in each generation from the third to the tenth there was one from whom there were two lines of descent That alone would reduce the number 492 or nearly one-fourth. The more remote in degree, the greater would probably be the proportional loss by lines running to a common source.

There can be no approximation to the true number that would be more than a more or less shrewd guess—my own is no better than anyone else's—and it is that in twenty generations the total number of one's ancestors is not likely to exceed 20 000 or an average of 1 000 to the generation and that the number in each preceding generation is more likely to decrease than to increase

After arriving at the true number of one's ancestors in each degree, if that were possible, the total would be subject to considerable deductions on account of the same person's being an ancestor in several different degrees, as would be the more likely the more remote the relationship. R L. FLOYD.

El Dorado Ark

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THE NUMBER OF OUR ANCESTORS AND OF OUR FUTURE COUSINS.

To the Editor of the SCIENTIFIC AMERICAN

The problem which has been discussed by a number of your correspondents, in regard to the number of our ancestors, while very puzzling has given rise to another quite as puzzling to my mind and even more disquieting.

It appears evident that to have kept good the number of the human race, or of any other race each pair must on the average have produced two offspring who matured and reproduced themselves in two individuals, and so on, this merely on the supposition that the number of the race remained stationary although it is generally supposed the human race has increased through the ages However adopting the first *supposition, as very moderate surely, I cannot* escape the following conclusions

A has two parents each of whom had one brother or sister and each of these collateral relatives has two children Therefore A has four first cousins or four cousins of his own generation descended from the collateral branches one generation back. Likewise from the four collaterals to his grandparents he has sixteen cousins of his own generation from the eight collaterals to his great grandparents he has sixty-four cousins of his own generation, etc or in general A has 4^x cousins of his own generation descended from ancestors *x* generations back

This gives us startling results From the ancestors ten generations back A has over a million cousins fifteen generations back over a billion, and this takes us back only about five centuries If we go back another century or eighteen generations, A must have about 64 billion cousins and we are still in very modern times.

Now, what has become of all these myriads of cousins? They are *not on* the earth Where are they? And worse yet because it looks to the future what of A's children? They must have four times as many cousins as he, and his grandchildren must have sixteen times as many The prospect looks dark to me I am more concerned about the cousins of the future than I am for the ancestors of the past

Sugar Grove, Ill. A T MICHELL.

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WHY DO MAIN SPRINGS BREAK?

To the Editor of the SCIENTIFIC AMERICAN

Inasmuch as I have had over thirty years experience in fitting some thousands of main springs to watches I believe that I may be able to add some*thing to the article entitled* 'Why Do Main Springs Break?" which appears in your issue of September 4th 1909

I have found in my experience that the main spring of new watches break when the watch has been in use only for a few days. The cause may be attributed to the excessively high tempering of the steel, and in some cases to the uneven tempering of the steel Moreover any mineral or vegetable oil will corrode the main spring because of the presence of acids in the oil During my entire experience I have never been able to obtain any mineral or vegetable oil free from acid The only oil that I have used with success is purified fish oil

I have found that main springs also break into many pieces because the watchmaker has carelessly handled the spring with perspiring hands. Some watchmakers when cleaning a watch steep the main spring as well as the other parts either in benzine or kerosene to save time This practice will surely cause the main spring to break within a very short space of time, because of the acids in the benzine or kerosene which penetrate the steel Even though the spring be afterward *oiled with good fish oil* it is sure to break after this dipping in kerosene or benzine

If a barrel arbor around which the main spring coils is made too small in time the spring will break close to the center which is an infrequent occurrence particularly in modern watches

When the watch repairer finds that a spring has lost its resiliency instead of replacing the old spring with a new one, he will sometimes take the spring in his hands and straighten it by drawing it between his thumb and fore finger thus restoring its resiliency temporarily At the same time however he makes the spring more brittle and breakage is sure to follow such treatment

In conclusion I wish to concur with your contention regarding the breakage of main springs during hot weather particularly when taking the watch from the pocket and laying it suddenly on a cold marble or iron slab RICHARD B SMITH

New York

OPEN-AIR ORCHARD HEATING IN COLORADO

BY W. FRANK McCLURE

The 1909 crop of fruit in the Grand Valley in Colorado from the Palisades above to Loma below valued at $3 000 000 owes its existence to a unique battle which was waged against Jack Frost at a time when the fruit was at its tenderest age By unusual generality and the work of hundreds of enthusiastic volunteers the temperature in these orchards was actually raised eight and nine degrees over 27 miles of territory and a precedent was established which will mean much to the future In California it is said that the temperature has been raised heretofore in some single orchards two or three degrees but never to eight degrees and never before has the work been carried on over so great an area Plans are now on foot to have every bearing orchard in the Grand Valley protected by next season not that there is any likelihood of frost every spring in this section but because the protection against possible repetition of this years experience is considered cheap insurance Representatives of other fruit growing sections have also recently visited the Grand Valley sent there from their several communities to learn more of the recent experiment

The raising of the temperature over this large area was accomplished by means of some 300 000 smudge pots of many different types some burning oil for fuel and some coal and placed at intervals in the orchards after the manner shown in the accompanying photograph Oil was carried to the pots in wagon tanks equipped for the purpose. Spraying machines were also used in distributing the oil A large supply of lighters was kept in readiness in a dry place Many of these lighters were made by wrapping waste about a twisted wire

All operations were directed from Grand Junction Weather stations established over much of the territory and equipped with thermostats when the threatening weather arrived made half hourly reports on the temperature to Grand Junction

When finally the danger point was approaching warning was sent to all the ranchmen to light the fires Volunteers also in nearly all walks of life made their way in automobiles and wagons and on bicycles over the entire area The Trades and Labor Assembly adjourned its meeting and worked all night rendering assistance. Men worked in shifts, some at night lighting the fires, and others in the daytime filling the pots Even women assisted in the work. The campaign in all lasted four days.

So well did this orchard-heating idea work, that while the temperature outside the heated area dropped as low as 20 degrees within the heated area it did not go below 29½ deg Seventy five per cent of all the fruit trees which were in bloom were cared for directly while even orchards owned by those who were skeptical of the idea were saved by the fires in the adjoining territory

As previously stated there were a great many different kinds of pots used in this work The number used per acre depends upon the size Forty 60 or 80 pots per acre was the average When coal is used it is usually lump or nut. With coal at $4 a ton some one has figured that it cost him $4 per acre to heat his orchard for a six hour run Some of the oil heaters are used to the number of 60 or 80 to the acre In the opinion of some it is better to have a small-sized pot and use more to the acre, say 60 or 80, as just stated

Taking one of the many kinds of pots as an example and figuring coal at $4 a ton the cost of equipping with heaters and all other facilities for the first year for ten acres is estimated at $449 25 and for the second year $186 25 This provides in the initial cost for 800 heaters, or 80 to the acre It also provides for 40

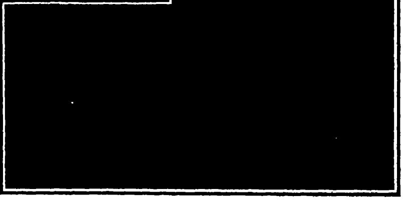
One of the many different styles of pots used in smudging.

An oil pot with hood in place.

Another type of pot in which oil is used.

Spraying the trees with apparatus which also conveys oil to the pots.

Raising the temperature in a Colorado orchard.


A photograph taken late in the evening, showing coal pots with draft covers set

Typical Colorado orchards; young trees in the distance.

OPEN-AIR ORCHARD HEATING IN COLORADO.

tons of coal, kindling lighters, 50 pounds of waste, 200 gallons of oil for lighting, the storage for oil, and the building of a coal house. For the first year's equipment for oil pots, including 800 pots for ten acres, and fuel at 5 cents a gallon, the cost is estimated at $494.35, and for the second year $153.75

Now that the question of raising the temperature even 10 or 15 deg. over a large area has been settled beyond doubt, the next problem facing the fruit growers is that of regulating the temperature and economy of fuel and labor For example, there is no need of raising the temperature 10 deg. when raising it 2 deg. will put the blossoms out of danger Some are planning to meet this problem by having a large number of small pots and only light enough of them to keep the temperature above the danger point. Others have devised pots with a system of drafts, so that the heat may be increased or decreased as is necessary

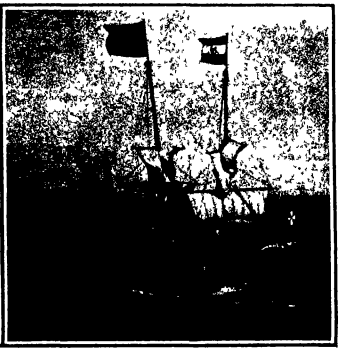
The fruit ranches of the Grand Valley are very extensive. One, for example, contains 242 acres, and is valued at a quarter of a million dollars. Its crops include peaches, apples, pears, plums, cherries, and soft-shell almonds. An army of people is required to pick the fruit. By another season it is expected electric lines will be running out to the orchards all over the valley, and refrigerator cars will be carried right to the orchards.

THE VISITING WARSHIPS—A COMPARISON

Because of incompetence in its management the naval parade, which should have been one of the most attractive features of the Hudson Fulton Celebration, came very near being a complete failure, and it was only redeemed by the fact that its line of travel lay parallel with the finest assemblage of warships that was ever gathered in the waters of the Western Hemisphere The very devil of mischance seemed to have been abroad on the morning of September 25th, and he became busy at the very outset, when the "Half Moon," in a laudable endeavor to show herself under sail, had no sooner spread her canvas, than she plumped squarely into the "Clermont," and came very near ending the career of that little craft there and then. The two great errors which made the parade a failure were, first, the anchoring of the "Half Moon" and the "Clermont" off 110th Street, instead of sending them under tow around the whole line from 42nd to 205th Street, and secondly the failure to dispatch the commercial steamers tugboats yachts etc two or three abreast and with reasonably short intervals between them As it was a vast part of the visitors both ashore and afloat, all, in fact who were above 110th Street, never caught a glimpse of the two vessels, the "Half Moon" and the "Clermont," in whose honor the parade was being held Instead, for them the procession consisted of a lot of detached and widely separated passenger steamboats big and little, which

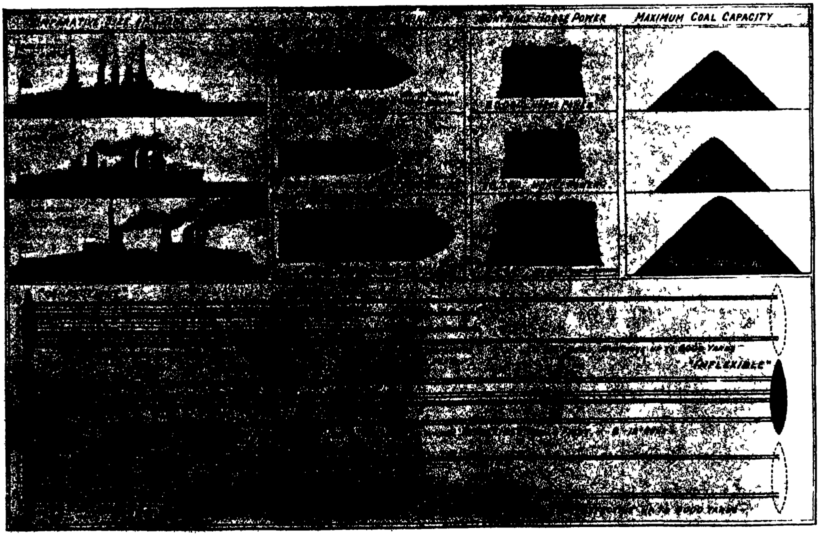
Displacement, 14,900 tons. Speed, 19.4 knots. Guns: Four 12-inch , ten 7.6-inch.

French Flagship, "Justice."



Copyright, 1909, by Pictorial News Co

The "Half Moon" under sail in the Lower Bay, New York



In an engagement with the "Connecticut" and "Justice" the "Inflexible" would try to fight outside the armor-piercing range of their secondary batteries. These batteries, however, would cut her unprotected parts to pi

THE VISITING WARSHIPS—A COMPARISON.

steamed leisurely around the fleet—vessels with which the majority of the spectators were already perfectly familiar, from the "Hendrick (*sic*) Hudson" down to our venerable friends the "Iron Steamboats."

It was the noble line of warships, nine miles in length however, that saved the day At the head of the line above Spuyten Duyvil, was the turbine-driven 26 knot scout cruiser "Salem" Astern of her were the armored cruiser "New York" the flagship of Admiral Sampson during the Spanish war and now fresh from a one million dollar overhaul in which she has been brought as far up to date as a ship of her age can be Then there was the "North Carolina," a handsome modern armored cruiser of the pre-"Dreadnought" period Below these in majestic array came the sixteen battleships which made the memorable voyage around the world Astern of these was the "Dreadnought" cruiser "Inflexible," the largest and most up-to-date warship in the fleet, with her three armored cruiser consorts, the "Drake" "Duke of Edinburgh," and "Duke of Argyll" Following these were the quaint wooden training ship "Portsmouth" and the Dutch protected cruiser "Utrecht" which was *anchored in the position of honor opposite the* water gate at 110th Street where the official reception of the "Half Moon" and "Clermont" took place Then came the four armored cruisers "Victoria Luise" "Hertha" "Dresden" and "Bremen" representing Germany Astern of these followed what in some respects was the most imposing of the foreign display namely the first-class battleships "Justice," "Verité" and "Liberté," flying the flag of France Astern of these were the protected cruisers "Etna" and "Etruria" of Italy the training ship "Presidente Sarmiento" of the Argentine Republic the gunboat "Morales" of Mexico, the U S gunboat "Newport" with the President's yacht "Mayflower" forming the last ship of the line.

THE "CONNECTICUT" "JUSTICE," AND "INFLEXIBLE"—A COMPARISON

Of the many navies represented at the Celebration there were three which contained fighting ships of sufficient powers of offense and defense to be placed in the first line of battle namely the French British and our own It is impossible within the limits of the present paper to discuss in detail the various units which made up this nine-mile line of warships with which most of which the readers of the SCIENTIFIC AMERICAN have already been made familiar We will therefore take the three flagships the battleship "Connecticut" of the United States navy the battleship "Justice" of the French navy and the "Dreadnought" cruiser "Inflexible" of the British navy and compare their fighting power under those conditions of long range fighting under which, we are told modern battleship engagements will be fought

The theory upon which the latest battleships of our own and modern navies are being designed and according to which the crews are now being instructed in target and battle practice, is based upon the belief that future engagements will be fought at extremely long ranges probably of five miles and over Now the most accurate gun and the one that can inflict greatest punishment at long ranges is the big gun and the bigger the gun the more accurate and deadly the fire It is in this fact that we find the explanation of the modern "Dreadnought" which is armed entirely in its main battery with the 12 inch gun the exception being the German navy which makes use of an 11 inch piece Now the determination of the range at which a battle shall be fought lies with the ship which possesses the greatest speed for if the enemy should attempt to close in the faster ship is always able to draw away On the other hand if the enemy should wish to increase the range or draw out of the fight altogether the faster vessel can still maintain the range and place herself on whatever

COMPARISON OF "CONNECTICUT," "JUSTICE," AND "INFLEXIBLE."

	"Connecticut"	"Justice"	"Inflexible"
Navy type	United States Battleship	France Battleship	Great Britain Cruiser Battleship
Length	450 feet	439 feet.	567 feet
Beam	76¾ feet	79½ feet.	78½ feet.
Draft	24¾ feet	28 feet	26 feet.
Displacement	16,000 tons.	14 900 tons.	17,250 tons.
Horse-power	20,000	18,550	50,000
Trial speed	18 8 knots.	19 4 knots.	28 knots.
Coal supply	2,300 tons.	1 825 tons.	3,000 tons and 700 tons oil
Main Battery	Four 12-inch	Four 12-inch.	Eight 12-inch.
Secondary battery	Eight 8-inch Twelve 7 inch.	Ten 7.6-inch.	
12-inch gun protection	12 to 10-inch	13½ to 11 inch	10-inch.
Secondary battery protection	7 to 6-inch	6¼-inch.	
Belt armor.	11 to 4-inch.	11 to 7-inch.	7 to 4-inch

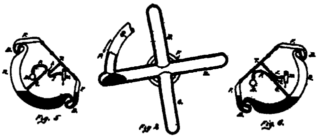
(*Continued on page 271*)

A NOVEL AIR PUMP AND VACUUM GAGE.

BY THE BERLIN CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

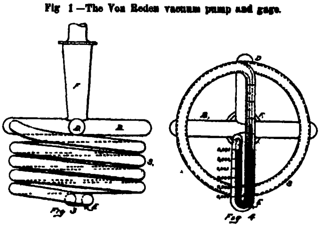
The most indispensable auxiliary of the physicist intent upon investigating those mysterious radiations the study of which is becoming more and more important is doubtless the air pump. For that reason many scientists and engineers have endeavored to improve the existing types of air pumps and have designed novel systems. One of the most interesting is that invented by Dr. Von Reden, of Franzburg, near Hanover

This is a mercury pump, the design of which will be most easily understood by reference to Figs. 5 and 6 The pump consists of a tube filled one-half with mercury, as indicated by the shaded portions. This tube is provided at its two ends with S-shaped tubes B and at its middle with a straight tube C The S-shaped tubes are connected on both sides to widened portions F, connected by rubber tubing with a T-shaped tube and thence by tube I with a water supply W The straight tube C and the bulb D to be exhausted are connected by a rubber tube P The entire apparatus turns round a pivot A.



Various positions assumed by the vacuum gage

Fig 1—The Von Reden vacuum pump and gage.



Spiral glass tube attached to two cross tubes.

A NOVEL AIR PUMP AND VACUUM GAGE

After having produced a preliminary vacuum (of about 20 millimeters of mercury) in the bulb D, and the apparatus, by means of the water pump W, the apparatus is oscillated from the position represented in Fig. 5 to that of Fig. 6 and back. The mercury remaining in the S-shaped tubes B acts as a pressure valve, and prevents the air in the enlarged portions F from returning to the tubes B. On the other hand, the air entering from the bulbs D in both positions, through C [illegible] driven by the mercury [illegible] of the apparatus through the [illegible] hand S-shaped tubes respectively, in order to be [illegible] tually discharged by the water pump. The [illegible] ing tube R, which, owing to its [illegible] would [illegible] very efficient, is advantageously replaced by a [illegible] tion consisting of ground-glass joints in the shape of perforated glass balls, fitting tightly in the [illegible] polished hemispherical cap, as shown in a [illegible] illustration, Fig. 1. In order to connect the ball with the cap, metallic springs may be employed.

Fig. 1 represents to the right a turbine belted to a pulley, which oscillates the tube by means of gearing and a crank mechanism. The glass ball joints lead to the spiral vacuum gage and the joint provides a connection with the bulb to be exhausted. A short-arm manometer is mounted below the bulb.

The pump above described can exhaust within three minutes a bulb of about 500 cubic centimeters capacity (a preliminary vacuum having been previously obtained by means of a water pump) to 1/100 of a millimeter of mercury, in four minutes, to 1/1000; in five minutes, to 1/10,000, and in thirteen minutes, to 1/100,000 millimeter of mercury, the lower handle being turned at the speed of six revolutions per minute. All the air should be expelled from the two vacua F, in order to obtain the vacuum last named. This is effected when the pump has been given its maximum inclination by means of the mercury, which on entering the apparatus throws back any residual air through the cocks H and H', closed rapidly after the tube R has been kept oscillating for seven minutes. The pump is stopped only for a very short time.

The vacuum gage represented in Figs. 2, 3, and 4 consists of a spiral glass tube attached to two cross tubes (Fig. 3) The left-hand tube B incloses a small amount of mercury, and the cross tubes B, D, C are mounted on a standard ground-glass joint, the conical angle of which is accurately given

By turning the spiral round on the axis of the joint G in the direction of the arrow P (Fig. 2) the small amount of mercury represented at the left of Fig. 3 is made to enter the spiral, there compressing the exhausted air, until after a number of revolutions it enters the U-shaped tube E of Fig. 4, in order there to occupy the position marked. The left-hand arm of the U-tube is so graduated that the divisions 0 001, 0 002, etc., to 0 006, limit 1/1000, 2/1000 etc, to 6/1000 of the total capacity of the U-shaped tube and of the spiral in the upper portion of the capillary tube. The right arm of the U-shaped tube is graduated to millimeters. In the present case, the exhausted air of the spiral is compressed as far as the division 0 001, that is, to 1/1000 of its previous volume, in the right arm of the tube, the mercury takes up a position 16 millimeters higher As, however, the atmospheric pressure in the bulb to be exhausted is 1/1000 of the pressure read on the gage, its value has accurately been 16/1000 millimeter

The spiral gage will indicate vacua up to 1/10,000 millimeter The only distinctive feature of the one used in measuring a vacuum of 1/100,000 millimeter is its being provided with a longer spiral and thinner U-shaped tube.

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According to a consular report dealing with the trade of Chinkiang, it is proposed to build a railway from Kuachou, at the mouth of the Grand Canal, to Tsingkiangp'u and Hsüchoufou, and thence joining the Peking-Hankow line via K'aifêngfu. This line has been surveyed, and the money is being asked for among Chinese merchants. The enterprise, the report states, is to be purely a "people's undertaking." The Chinkiang-Hsüchoufou-K'aifêngfu portion is to be laid first, as the canal provides a temporary transport for goods from Tsingkiangp'u southward, and therefore this portion is not so pressing. The line is to be finished in four or five years. If the Tientsin-Pukow line gets into working order first, a great deal of the trade of Chinkiang must go to Nanking, and may never be recovered But although the future prosperity of this port would seem to depend upon the new line in question being ahead of the Tientsin-Pukow line, the wealthy merchants of Chinkiang and Yangchow and other places seem still reluctant to subscribe the necessary capital, nor will they consent to a foreign loan, however favorable in terms. It was hoped that this being a "people's line"—the Tientsin-Pukow line being official—would commend itself to the merchants [illegible] but the reason for want of support is to be [illegible] the want of confidence [illegible] placed in the [illegible]

Handy Man's Workshop

SIMPLE BLUE-PRINTING FRAME.

BY C. L. SWEENY

For those desiring to make a few small blue prints, and having no regular printing frame, the following may prove useful.

Fig. 1.

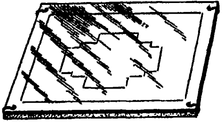

Fig. 2.

SIMPLE BLUE-PRINTING FRAME.

Secure a piece of ordinary window glass, somewhat larger than the largest blue print desired. If a piece the same size as your drawing board can be secured, it will be very convenient. Bind the edges of the glass with adhesive tape, to prevent scratching the tracing or hands. Cover the drawing board with felt or other heavy cloth, drawing the covering over the edges and fastening with thumb tacks. Make four clips, as shown in the accompanying illustration using thin spring brass or wire The exact size of clips depends on the thickness of board and glass.

In use the sensitized paper, which can be obtained from dealers in photo supplies, is laid on the felt, coated side up, the tracing to be copied is placed in position and covered by glass, which must be clean than the clips which hold the whole in position are slipped on at the corners.

THERMOSTATIC REGULATOR FOR SMOKE PIPES.

BY R. A. JONES.

The accompanying illustration shows a simple way in which to make a thermostatic regulator that will automatically open passages in the smoke pipe, to admit cold air, thus checking the draft of the furnace, and eventually cooling off the fire. The regulator should be placed as near the furnace as possible. Fig. 1 shows a sectional side elevation of the thermostatic regulator, and Fig. 2 a horizontal section of same In a short piece of pipe, say about 6 inches long, a number of openings are made These openings are covered with the thermostatic band, which is made as follows: A ring about 2 inches wide, and about 1 inch larger in diameter than the pipe, is made of galvanized iron. The edges are turned down by hammering, as shown in Fig. 1. These turned-down edges are fitted closely to the pipe. In the recess thus formed, a strip of brass or preferably copper is placed and riveted very closely, say about 1 inch apart, so that when the copper expands it will not buckle.

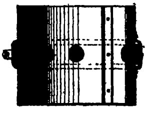

Fig. 1

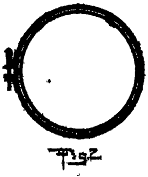

Fig. 2

REGULATOR FOR SMOKE PIPES.

To the above-mentioned galvanized ring, opposite the joint, small lugs may be provided for the purpose of fastening same to the pipe. The ring is now cut at the joint, and the ends turned in and fitted closely to the pipe. Two small lugs are riveted to these ends of the ring, with holes to receive a small stove-bolt. Between the head of this bolt and the lug on one side, place a stiff coil spring. This serves the purpose of regulating the tension of the ring so as to make it more or less sensitive to heat.

As the fire gets too hot, the copper expands more than the iron ring, causing it to move away from the pipe, and cold air from the outside will pass between this ring and the pipe into the holes of same, thereby checking the draft to the furnace, and preventing it from over-heating.

Under normal conditions, of course the spring does not open, but only under excessive heat, then it will stay open until the furnace cools off.

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CIRCULATING PIPE FOR HOT-WATER FAUCETS.

BY J. A. [illegible]

In turning on a hot-water faucet, it is always necessary to let the water run for some time before it gets hot. The cause of this is that the water standing in the pipe soon cools off, right up to the boiler owing to the fact that there is no circulation in same and of course a great deal of water is wasted It is an easy matter to overcome this by connecting the back of the faucet to the bottom of the boiler with a small pipe A, shown in the accompanying drawing, Fig. 1.

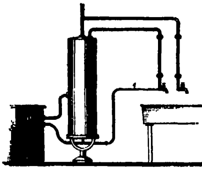


Fig. 1

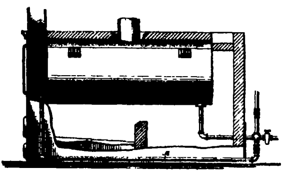


Fig 2

CIRCULATING PIPE FOR HOT WATER FAUCETS.

It is now evident that as soon as the hot water in the supply pipe cools off, owing to the change of specific gravity, it will pass downward into the circulation pipe and back to the boiler, and of course a fresh supply of hot water will flow constantly from the boiler to the faucet, and will keep up as long as there is a difference in temperature at the top and bottom of the boiler

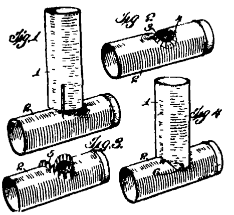
This also holds good in a steam boiler Fig 2 shows an ordinary horizontal tubular boiler Most of these boilers are fed through the blow-off pipe. This pipe is considered a weak part of the boiler, owing to the fact that the boiler is not fed constantly, but at intervals. Therefore these pipes are always required to be covered with asbestos, and sometimes protected from the hot gases by a brick wall If the boiler were fed constantly, that is to say if there were a circulation of water in this pipe at all times, the gases would have little effect on same As soon as the feed water is shut off, or rather between the intervals of feeding, this pipe is full of water which cannot circulate, and is liable to be overheated and burn To overcome this, a circulating pipe A is connected inside the blow-off cock to some part of the boiler say to the lower part of the front end A check valve may be inserted into the line, to prevent the feed water passing through the same. This pipe will at all times establish a circulation in the blow-off pipe, and eliminate all danger of being burned out.

HOW TO CONNECT STOVE PIPES.

BY H G L.

The man who desires to connect two stove pipes together and has not the tools ordinarily used for this purpose can do the work as follows

Place one end of pipe 1 against the side of the pipe 2 at the point where it is to be connected With pencil flat against the side of pipe 1, as in Fig. 1 trace off the curve on pipe 2 Leaving about 1 inch margin, cut out a disk 3 slit the margin back to the line as at 4, and turn up the tangs 5 Force the end of pipe 1 through the opening, and trace off the curve of pipe 2 Withdraw pipe 1, and cut off the end as marked. Now fit the pipe 1 into place with the tangs 5 on the inside and bend the tangs up to a tight fit. If carefully executed the joint will be sufficiently tight for all purposes



SIMPLE METHOD OF CONNECTING STOVE PIPES.

To hold the pipes rigidly together, punch small holes through the opposite sides with a sharp punch and put in a piece of stiff wire 6 Bend the ends of the wire on the outside The wire should pass through the tangs on the inside

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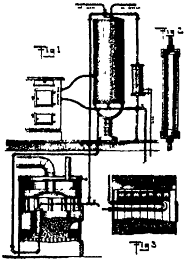
HOT-WATER CONNECTION FOR KITCHEN BOILERS.

BY JOHN B. ALLEN

In houses where the cooking is done exclusively by gas and with no fire in the kitchen range in the winter the question of having hot water in the kitchen boiler has been quite a problem in many a household especially as it is very expensive to heat this water by gas.

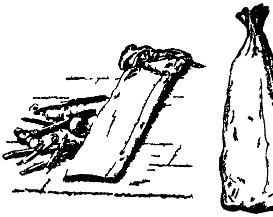
One solution of the problem is to connect the heating apparatus in the cellar with the kitchen boiler and if this be done properly there will be an ample supply of hot water at all times in fact more than needed in extreme cold weather, besides keeping the kitchen warm in the absence of any other source of heating Of course a steam or hot water radiator placed in the coldest part of the kitchen will improve conditions in severe weather

It must be understood that it takes a little more coal to run the heating apparatus although some contend that it does not Fig 1 shows a steam boiler in the cellar connected up with the kitchen boiler, also a separate gas heater for use in the summer It will be noticed that there are three independent circulations for the water, which will not interfere with each other—the circulation from the kitchen range, the one from the furnace and the other from the gas heater The connection from the furnace steam or hot water heater in the cellar or basement may of course be varied according to local conditions The accompanying illustration shows two good and reliable ways of making the connection Assume that the kitchen range is connected to the boiler in the usual way, then the connection with the furnace is made



CONNECTING THE KITCHEN BOILER TO THE FURNACE.

as follows Unscrew the hot-water connection on top of the boiler and insert a street cross If this cannot be obtained two street tees will answer the purpose. Then replace the hot water connection in this cross as before From one of the side outlets of this cross run a pipe line to the furnace and from the other to the gas heater It is well to start and finish the lines with a union as it is then an easy matter to disconnect them in case the kitchen boiler gives out or any repairs are needed The line from the boiler is run from top of same into the furnace thence down through the fire pot and grate in such a manner that it does not interfere with the proper working of the latter Thence through the side of the ash pit and up to the bottom of the kitchen boiler It is now evident that as the water in the heating pipe inside the furnace is heated it rises and fills the top of the boiler forcing the cold water out at the bottom



HOW TO CONVERT A PAIR OF OVERALLS INTO A TOOL BAG

Fig 2 shows a cross section of the heating pipe inside the furnace It consists of a short piece (say 2 inches) of extra heavy black pipe threaded at each end to receive reducing caps which connect with the pipe line Inside this pipe is another 1½ inches in diameter which leaves only a small space for the water to circulate in that is to say the water is spread out in a very thin sheet which very easily heats Three small sections on top and bottom of this pipe about ⅛ inch wide are turned outward so as to fit the inside diameter of the outside pipe and thereby keep it central Outside the furnace is placed a faucet or stop cock so that the sediment may be drawn off which should be done at least once a week

Fig 3 shows the other arrangement of a heating pipe inside a sectional boiler In the back of the boiler over the fire line drill two holes about 8 inches above each other into which insert the pipes about 2 inches in diameter reaching nearly across the entire fire space Connect the same with a return ell or make it up with ordinary pipe fittings At the outside of the boiler reduce these pipes to the regular size used for the pipe line which is usually ¾ inch in diameter Attach a faucet to the lower one and connect it to the bottom and the higher one to the top of the kitchen boiler Care should be taken in running the hot water pipe from the boiler not to trap it that is to say not to let it drop on the horizontal run but rather give it as much of a rise as possible If the run from the furnace to the boiler is very long the hot water pipe may be covered with asbestos or the like A stopcock may be put in either or both lines so that the water can be shut off in case of repair The gas heater is connected at the top and bottom to the top and bottom respectively of the boiler

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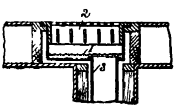
A SCREEN FOR THE REGISTER

B J A BROPHY

A simple and very effective means for preventing articles dropped on the floor from falling down the hot air pipes is shown in the accompanying illustration Cut a piece of wire mosquito netting 1 the size of the floor opening By lifting out the floor register 2 the netting can be placed over the opening in the hot air pipe 3 as shown Better still bend a piece of stiff wire to the shape of floor opening and after turning the edges of netting over this frame sew the netting to the frame with fine wire Galvanized wire netting is preferable to the painted netting The writer has been able by this method to reclaim several articles of value that had dropped into a floor register



A SCREEN FOR THE REGISTER

THE BOILER MAKER'S TOOL BAG

BY A F [illegible]

When the boiler maker gets a rush order for repairing a boiler he gets busy Quickly converting his overalls into a tool bag he drops in half a dozen chisels expander hammer etc and then he is ready for action In making the bag he places the overalls full length on the floor folds one leg up and lays it on the seat of the overalls then rolls the two very tightly together criss-crosses the suspenders and ties them on the part which appears in illustration. He then puts his hand inside the leg left full length and grasps the roll and turns the whole thing inside out This completes the bag which is ready to receive the tools which of course, come against the outside of the overalls leaving the side that comes next to his garments as clean as ever

◆

COATING ROOFS WHITE TO REPEL HEAT RAYS

BY A. S JARMAN

The almost general practice of painting the metal covering of the roofs of houses with the red or chocolate-colored oxide of iron is one of the causes of the insufferably high temperature of top rooms or attics during the summer months Although good as a covering for metal this paint because of its color absorbs the heat rays and conducts the heat to the interior The roof-covering material is not always metal If tar paper or tar felt and gravel have been used no kind of white paint will retain its color upon them If the covering is zinc this metal is apt to prevent the adherence of paint particularly when new Although white paint made with oil and driers can be used upon a roof previously covered with chocolate-colored paint another material must be used for a tar and gravel roof To secure a thoroughly adhesive coating upon new zinc brush over the metal the following mixture Sulphate of copper two ounces chloride of copper two ounces salammoniac two ounces water one gallon When the salts have become dissolved add two ounces of spirit of salt (common hydrochloric acid) Allow this to dry upon the zinc for about twenty four hours when it will be found that any kind of oil paint will adhere perfectly to the zinc

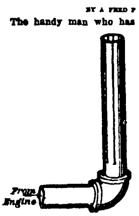
For a tar roof use a freshly made mixture of lime wash moderately thick and hot Two coats of this will adhere firmly to the tar and retain its white color as well as becoming very hard and resisting rain without washing off If the lime mixture has become cold the hardening property will be lost In that case to every pailful add a double handful of common salt Stir in well until dissolved This will revive the hardening quality The interior of the rooms with roofs painted or lime washed as above will be found from ten to twelve degrees lower in temperature

◆

A MUFFLER FOR GAS ENGINES.

BY A FRED P NOR AN

The handy man who has a gasoline engine in his shop and which exhausts outside into the atmosphere may silence that disturber of the peace somewhat in the manner shown in the accompanying illustration It removes the sharp penetrating quality of the noise without causing any back pressure The end of the exhaust pipe which must be vertical in order to prevent clattering of the segments is split into eight parts by means of longitudinal cuts made with a hack saw The cuts should extend for three or four feet in the pipe



SLOTTED EXHAUST PIPE SERVES AS A MUFFLER.

◆

TO PREVENT COAL GAS

BY L. O HANDY

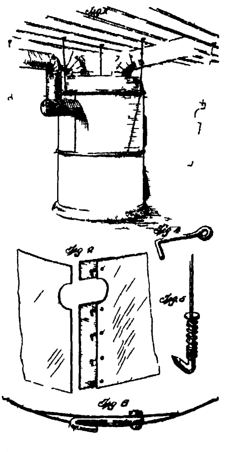
The extremely objectionable presence of coal gas in a furnace-heated house is really a simple thing to prevent. It is due of course to leaks in the air ducts through which the gas generated in the furnace enters and mixes with the fresh air that passes to the rooms above To gain access to the interior of the furnace so as to stop the leaks may appear to be a task quite beyond the average amateur's capabilities but the accompanying drawings show how the writer succeeded in doing the trick in a simple way

The top of the furnace carrying the heating pipes rested upon a cast iron ring and it was a simple matter to raise the whole thing bodily by the arrangement shown Three strong hooks were made out of large nails and under the head of each a piece of stout wire was fastened. The hooks were slipped under the iron ring. The ring was raised and the wires wound upon heavy nails driven into the beams overhead.

A 1-inch lift was sufficient and did not interfere with the heating pipes in any way but relieved all weight from the main band of the furnace and left it free to be laid open This was done with a pair of tinner's shears. The band was simply slit at the back where the heavy dotted line appears on Fig. 1 The two ends were spread apart and temporarily supported by wires to the rafters The entire interior of the air box was now accessible

Several open cracks were found Through these the gases of combustion had passed freely into the fresh-air compartment and thence to the rooms above A can of asbestos cement was obtained from a hardware dealer All surplus rust was scraped off from around the cracks with an old knife and the cement was applied freely Care was taken to squeeze enough into the cracks to insure a good hold All cracks were treated in this way and the important part of the job was finished

To reconnect the ends of the band five small holes were punched an inch from each of the two edges and exactly opposite each other From a piece of heavy iron wire five hooks were bent to the form shown in Fig. 4 These hooks each measured 2 inches from the center of the eye to the band A strip of galvanized sheet iron about 8 inches wide was punched with holes to correspond to those in one end of the band Small bolts about ⅜ inch long were used to bind all firmly together The free ends of the hooks were now passed through the holes in the opposite end of the band and bent down The strip of sheet metal on the inside formed an effective seal as clearly shown by the section Fig 3



METHOD OF REPAIRING A LEAK IN THE AIR DRUM OF A FURNACE

The band being closed the top was now lowered and the furnace was ready for use The whole job consumed slightly over three hours

The cement may need to be removed next year and to facilitate this task of the future the hooks were conveniently looped up into the rafters The back may be readily reopened by bending up the ends of the hooks and to repeat the work should not take more than an hour

Since this job was completed my fire has been made three times without the slightest trace of smoke or gas in the house

◆

In the Revue de Métallurgie Le Châtelier advocates autogenous welding for the repairing of marine boilers Referring to the important work that has been done especially in Germany in the welding of fire-boxes to boilers by the aid of water gas he expresses the conviction that the same work could be done better by the autogenous process A large French ship-building company is employing the process in order to dispense with riveted joints in the parts of boilers that are exposed to fire heat and in one case it is stated the bracket supporting the grate of a boiler has been replaced by a fitting welded to the metal of the grate and of the fire-box

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

HOOK AND EYE.—C. A. Lichtenstern, New York, N. Y. The more particular purpose of the invention is to improve the construction of both the hook and the eye for the purpose of improving the locking connection therebetween, so as to render the hook and eye rigid relatively to each other when in position on a garment.

Electrical Devices.

AUTOMATIC TEMPERATURE-INDICATOR.—W. B. Campbell, Chester, S. C. The invention relates to devices for automatically indicating a predetermined temperature. It provides a temperature indicating device whose operating parts consist of metal and which is not subject to the danger of breakage like the thermostats which have the common glass tube filled with mercury.

KNOCKDOWN ARMATURE.—B. W. Pressey, New York, N. Y. This armature is mounted in a field core within permanent magnets, and gives a high potential current of unusually steady character with a low number of revolutions. It is in no danger of burning out its coil at high speed, and consequently it needs no governing or protecting device. Its capacity can be changed by the removal of the single screw and substitution of another coil of any size of wire.

Of Interest to Farmers.

CULTIVATOR.—N. Tripp, Grand Rapids, Mich. This cultivator pulverizes the soil and whips the dirt from the roots of weeds, etc. The drum has spring digging teeth which incline oppositely to the revolution of the drum whereby they will be lifted rapidly from the ground on reaching a vertical position. The motor for driving the drum is carried on a wheel supported bed, and the drum is journaled in a frame which is pivoted at its front to move vertically relatively to the bed when raising the cultivator above, and lowering it to the ground.

RIDDLE FOR ROOT EXTRACTORS.—B. G. Patterson, Addington, Okla. The invention is especially adapted for use in machines for extraction of Johnson grass which propagates by means of seed roots which make a very rapid growth forming a mat in the soil so that it becomes impossible to cultivate any crop therein.

HYGROMETER FOR INCUBATORS.—G. H. Lee, Omaha, Neb. More particularly the invention relates to hygrometers known as "wet bulb" hygrometers, and it provides means for holding the evaporating fluid around the bulb. The invention also resides in the scale of the barometer which especially adapts it for use in an incubator.

STRAW AND MANURE SPREADER.—W. G. Derwiler and J. E. Isenbarger, St. John, Kan. The principal objects here are to provide a mechanism for distributing the materials being handled, by power applied through the carrying wheels of the vehicles to provide means for feeding the material being handled to the distributing members and to provide an operating construction free in operation.

Of General Interest.

MAIL-BOX AND LETTER-CARRIER'S POUCH.—L. Vinski, Jersey City, N. J. The box and the pouch are adapted to be connected with each other at their closed bottoms which latter are then capable of opening into the pouch, to allow the contents of the box to drop into the pouch, the latter on being disconnected from the mail box causing an automatic closing and locking of the bottoms of the box and pouch.

LOCKING DEVICE FOR UMBRELLAS AND THE LIKE.—W. L. Stebbing and G. R. Paine, Jacksonville, Fla. Means provide for locking the runner sleeve and attached stretcher rods of an umbrella or parasol in closed adjustment on the umbrella stick, the means embodying a locking slide bar and a permutation lock mounted on the stick, comprising a plurality of cup shaped rings having indicating characters thereon, the rings by adjustment controlling the sliding movement of the slide bar for locking or releasing the runner sleeve.

AUTOMATIC PIANO.—H. Meyer, New York, N. Y. The aim of this inventor is to provide a new and improved automatic piano having a simple and effective connection between the pneumatic and the keys for playing the piano automatically and for allowing playing the keys by hand.

REMOVABLE CALK.—G. S. Meyer, Newburgh, N. Y. The principal object of the present invention is to connect the calks which extend transversely of the under side of the shoe more firmly to the outer member which encircles the hoof, and to provide for the relative movement of the opposite halves of both the inner and outer connecting members.

REMOVABLE CALK FOR HORSESHOES.—G. S. Meyer, Newburgh, N. Y. The object of the present invention is to provide means for effectively holding the calks in engagement with the shoe without the necessity for a separate member extending along the inner edge of the shoe, as is employed in Mr. Meyer's prior constructions.

HORSESHOE CALK.—G. S. Meyer, Newburgh, N. Y. In the present patent the object of the inventor is to simplify the calk and reduce the cost of manufacture by forming not only the calk but the part for securing the same in place, all out of a single piece of sheet metal bent to the desired form.

REMOVABLE HORSESHOE-CALK.—G. S. Meyer, Newburgh, N. Y. This invention has reference to improvements in removable horseshoe calks, and more particularly to a special form of construction whereby the calks are held in place in respect to the shoe, but all danger of the calk-bearing members being torn off by interference is avoided.

PILE-PROTECTOR.—C. N. Hubbard, Kamela, Ore. In this case the invention has for its purpose the provision of a suitable device for automatically applying the preservative along the length of the pile by the aid of the rise and fall of the water level, thus in tide water giving the pile four applications of the solutions daily.

ORE WASHER AND CONCENTRATOR.—A. Dieu, Medellin, Colombia. The apparatus comprises two troughs or basins one above the other, the upper one being spring supported and having an outlet for the concentrates at the center of the bottom through which the concentrates are delivered to a second trough with a quantity of water added and retreated. The bottom outlet for the first basin is automatically regulated by the weight of the material in the upper trough.

COMBINATION CENTER SQUARE.—P. H. Allison, Torrington, Conn. In this instance the improvement refers to measuring instruments, and the object is to provide a new and improved combination center square more especially designed for accurately determining the center of round work, for laying out angles and for use as a T-square, depth gage and scale.

DOOR CHECK AND CLOSER.—O. Anschütz, 115 Schanzenstrasse, Hamburg, Germany. The invention pertains to liquid door checks and closers and the object is to provide means whereby the beginning, middle and end speed of the door can be regulated. When the door is opened a piston is moved by rotary movement of a crank plate which is turned by means of the usual lever arm on the free end of a spindle, and the spiral spring is thereby wound up.

VALVE.—W. J. Bell, Jersey City, N. J. This valve has a stationary valve seat and a valve member resting against the same, this member being revoluble step by step always in the same direction so as to leave the parts alternately open and closed, one movement of the valve opening all of the parts and the next successive movement of the valve closing them, the next opening them again, and the next closing them again.

Hardware.

LOCK AND FASTENER.—J. Robertson, Perth, Ontario, Canada. The lock includes novel locking devices and a unique controlling means for the locking devices including a bar which is arranged to slide in the lock and extends into the knobs. The sliding bar is accessible to a person grasping either knob so as to be shifted to prevent turning of the knobs in opening the door. Provision is made for disposing the parts of the locking devices to convert the lock into a night latch.

LOCK.—A. Leonard, Ashland, Wis. The lock is such as used on doors, windows, drawers, etc. The aim is to produce a lock which can be operated without a key. It is specifically a combination lock, and in its construction it comprises a number of pins or plungers, which must be placed in a certain position before the lock can be opened.

FASTENER.—K. Green, Yazoo City, Miss. The improvement relates to fasteners, and more particularly to such as are adapted to be used with traces or the like and each of which consists of a hook having spring controlled locking means for engaging the nose thereof and movable in a plurality of directions.

THREAD CUTTING DIE.—L. Castracane, New York, N. Y. More particularly the improvement relates to that type of die in which each die proper is provided with a plurality of cutting faces, whereby the die may be adjusted to different positions to present different faces, and be used in cutting the threads on screws or bolts of different diameter.

DRAWER PULL.—C. B. Adams, New Orleans, La. The invention is an improvement in bolts designed for use on drawer pulls and the like although it is capable of use in other cases where bolts are put through wood or other elastic material. The bolt is adaptable to different thicknesses of board within wide limits without affecting the finish at both the inner and outer faces of the board to which the bolt may be applied.

Heating and Lighting.

MINER'S LAMP.—A. M. Van Liew, Houghton, Mich. The object here is to provide a light weight miner's lamp, which is compact in form which is adapted to burn wax or the like as an illuminant in which the combustion of the wax or other substance is complete, and which thus obviates the production of smoke and other noxious gases.

GAS SCRUBBING APPARATUS.—J. J. Nix, Los Angeles, Cal. The gas is cooled and passes into a scrubber and through compartments to wash the gas. A water seal for a pipe retards the gas on its travel to the retort and the duct, and is thus fixed, and a uniform temperature avoids local, intense and destructive heat. Successive sprays of water in the scrubber washes the gas and the latter passes by way of a pipe to the holder or to the engine or other machine.

Household Utilities.

DRAIN VALVE.—H. M. Kirby, Wilmington, Del. The object here is to produce a valve having means for normally holding the valve wide open, the valve having such a construction as will enable the valve to be locked by a simple movement in its closed position. The valve is especially adapted for use in connection with bath tubs, wash bowls and the like.

DISPENSING RECEPTACLE.—K. C. Tolling, Memphis, Tenn. More particularly this improvement relates to a receptacle for tooth powder, which has means for dispensing the powder at will from the container and which is provided with a chamber adapted to receive the end of the tooth brush so that the powder can be dispensed directly upon the bristles.

BOOK REST.—D. Duff, New York, N. Y. The invention provides a rest for use on tables, desks and other supports. It is simple and durable in construction, cheap to manufacture, attractive in appearance and arranged to permit convenient and quick extension or contraction according to the books to be accommodated at the time, and to securely hold the books in position.

Machines and Mechanical Devices.

DESICCATING AND PULVERIZING APPARATUS.—V. W. Mason, Jr., and G. I. Rockwell, New York, N. Y. The invention is designed especially for pulverizing the solid constituents of milk in converting milk into a powder or flour. The primary object is to take the pasty substance and convert it into a powder by a single operation instead of first drying the material and then pulverizing it.

ADDING AND NUMBER-LISTING MACHINE.—B. Hoskins, Seattle, Wash. This machine may be operated to add columns of figures, and will print a list of items added and also the totals of the different columns. Such machines are used extensively in banks, counting houses and similar institutions. The invention constitutes an improvement on the machine formerly patented by Mr. Hoskins.

BELT-TIGHTENER.—G. I. Wallace, Bridgeport, Conn., and R. Dow, Mansfield, Ohio. The tightener is designed more especially for use on polishing, buffing and like machines having the driving belt arranged within the column or hollow stand of the machine, the arrangement being such that the tightening pulley is located within the column and the actuating and setting device for the pulley is arranged outside of the column convenient to the operator to enable him to tighten the belt more or less.

DRIVING MECHANISM.—N. Swiatsky, New York, N. Y. In its preferred form the invention consists in combination with a driving shaft of a pulley journaled on the shaft having an extended hub portion, opposed bevel gears, one journaled on the shaft, the other on the hub portion of the pulley, an idle bevel gear intermeshing with opposed bevel gears and clutches for respectively connecting the gears to parts on which they are journaled and the pulley to the shaft.

STAMP MILL.—O. C. Pukkentin, Ashland, Ore. The object of the inventor is to provide means for driving the stamps or hammers in such a way that they will rotate as they strike, in this way producing a desirable grinding action which brings about a very fine reduction and uniform grinding of the ore treated.

UNIVERSAL JOINT.—D. Corcoran, Yonkers, N. Y. The joint consists of a disk having a semi-circular flange on each of its sides, the planes of the flanges being substantially at right angles to the disk and to each other, and two shafts in one of the terminals of each of which there is a semicircular slot, each of the flanges being disposed in one of the slots, there being curved slots on each flange, and a pin disposed in each of the shafts through the slots respectively.

ELEVATOR.—D. Corcoran, Yonkers, N. Y. The cage has a conical disk with spiral threads on its face, there being a series of studs in the elevator shaft on which are disposed rollers respectively, the threads meshing with the latter. The disk is secured to a shaft on the cage connected by a universal joint to a horizontal shaft having a driving pulley, an idler pulley being disposed thereover. A pulley is at the top and bottom of the shaft, a motor coupled to the latter and the former journaled in a box. The box lowers when the cage reaches predetermined elevations, and means provide for raising or lowering the cage independently of outside power.

THREAD AND TAPE HOLDER.—G. W. Wyinn, New York, N. Y. The invention provides an attachment which may be secured to the sewing machine table or top or any other table or factory table space, and which will serve for support of a plurality of spools of thread and a plurality of rolls of tape, ribbon, seam binding, or other similar material which it is desired to sew to the article or garment, and these spools and rolls are locked against displacement so that the employee cannot misplace or intentionally carry away a partly used spool or roll.

Prime Movers and Their Accessories.

ADJUSTABLE CRANK FOR INTERNAL-COMBUSTION ENGINES.—C. J. Gotel, Tuckahoe, N. Y. In the present patent the object of the inventor is to provide an adjustable crank for an internal combustion engine whereby the length of the stroke of the piston in the cylinder can be changed to vary the degree of compression of the charge.

Railways and Their Accessories.

DOOR.—C. W. Whitman, Watervliet, N. Y. This improvement in doors is especially designed to be used in connection with street railway cars and has for its purpose to automatically register the number of passengers entering and which will permit of the exit without operating the registering mechanism. The movements of the motorman on the platform will not be more restricted than when the usual type of door is employed.

LOG AND LUMBER CAR.—M. M. Hessel, Eau Claire, Wis. This inventor has devised and put in successful practical use an improvement comprising a novel stake socket attached to bunks formed of parallel bars preferably of railroad rails, and provided with a double chain attachment adapted to hold a stake firmly, and safely for the operator.

Pertaining to Recreation.

AMUSEMENT DEVICE.—B. Hess, New York, N. Y. Generally speaking, the invention consists in a series of sinuous undulating tracks connected to an undulating surface and which are adapted to receive a carriage which travels thereon, the carriage being adapted to carry an occupant whose feet rest on suitable supporting rollers which travel on the undulating surface.

SELF-SPINNING TOP.—O. F. Feras, Albany, N. Y. The object of the inventor is to produce a top having means whereby the top may be set spinning without using the ordinary means for this purpose. The device comprises a holder for the top having a resilient member which is adapted to be engaged by the top and which may be twisted so that in releasing the top it will exert a spinning force.

Pertaining to Vehicles.

END-GATE FOR WAGONS.—B. M. Wilhite, Gordon, Neb. The feature here consists in the employment of angle iron reinforcing bands. The bands are in pairs and bent so as to fit closely upon the exterior surface of the end gate plate and the wings thereon. Three pairs of angle iron bands are provided and fixed in place upon the end gate and wings by rivets or bolts, one pair being located at the lower edge of the end gate and its wings, another at their upper edges and the third pair midway between the other pairs.

SLEIGH-KNEE.—H. Wesle and H. Wesle, Medford, Wis. An object here is to provide means for movably attaching the clamp to the sleigh knee proper. Another is to improve the means of fastening the sleigh knee to the runner. It is an improvement on the construction shown in a former patent granted to Messrs. Wesle.

WIND-SHIELD.—J. H. Sibaugh, Norwalk, Ohio. This invention relates to improvements in wind shields for use on vehicles and more particularly to that type of shield which is formed of a lower stationary section and an upper movable section. It involves an improved form of supporting means for holding the two sections in any desired position in respect to each other.

SPEED-INDICATOR.—C. Knote, New York, N. Y. An object of the invention is to provide tension means for controlling the movements of the ball governor, said means including two separate springs, one of the springs operating while the indicator is rotated at slow speed, while the other spring comes into play when speed increases beyond a predetermined limit, and in connection with the springs means are provided for adjusting the tension of the springs at will.

SLEIGH-RUNNER FOR VEHICLE WHEELS.—J. Karssen, Holland, Mich. This invention refers to runners adapted to be detachably fastened to the wheels of a vehicle. It is an improvement on a former patent granted to Mr. Karssen. The improvement which it designs to make is to render the attachment of the runner to the wheel adjustable so as to fit wheels of various diameters and having various numbers of spokes.

LEAF-SPRING.—W. J. Harrison, West Derby, Vt. The spring is particularly adapted to motor vehicles and is designed to arrest the rebound which the conventional spring ordinarily gives when the vehicle is in motion. This is accomplished by providing the vehicle frame with spring hangers and a spring contractable in length under the weight of the load having its opposite ends connected to the hangers.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions, books, etc This will facilitate answering your questions Be sure and give full name and address on every sheet

Full hints to correspondents were printed at the head of this column in the issue of March 13th or will be sent by mail on request.

(12124) N R S asks Will you be good enough to supply me the following information? I wish to have some information as to reinforced concrete construction. One of my friends writes me a letter whose substance in asking the information is as follows My attention has been lately drawn to reinforced concrete construction. This method of construction is I believe, largely adopted in America and also to some extent in England and France I am inclined to give it a trial and construct one of my buildings entirely on that principle I have however just heard that this construction is likely to collapse after a few years owing to the corrosion of the metal which is imbedded in the concrete in order to strengthen and support the construction Will you get me some information on this subject which may tend to definitely dispel or confirm my doubts?" I shall be much obliged if you will send some information on the above subject, or direct me to any other reliable and authentic source A We can if you desire it, give you references to articles in our paper or books on the subject confirming our opinion, but without waiting to look these up we can assure you that your friend is entirely mistaken in the supposition that metal reinforcement in concrete is corroded by any action of the cement. Neat Portland cement even in thin layers, is an effective preventive of rust Tools have been taken out of concrete known to have been under water for four hundred years, as bright as when new Iron rods have been partly imbedded in some experimental blocks of concrete exposed to sea air, and after the external part of the iron had entirely rusted away the imbedded part had not appreciably lost weight Concrete to be effective in preventing rust, however, must be dense and without cracks, fa' res in reinforced concrete or corrosion of the inclosed metal being almost invariably traceable to bad workmanship. The concrete should be liquid enough to be tamped closely around the iron and this is especially important in cinder concrete on account of the moisture absorbed by the cinders.

(12125) P G asks Will you please explain the following questions? I was in New York city some time ago, and while there I visited Coney Island. I saw a show at Luna Park, representing the fight between the 'Monitor' and Merrimac" in Hampton Roads, Va The question is this What gives the stereoscopic effect? When I moved my head sidewise it had the vision of distance Of course the picture was on a curtain. Where was the machine located that projected the (moving) picture? There was no shadow of the curtain Also, please, a description of those long red tubular lights in the post office in New York city (not the Cooper Hewitt vapor lamp) A Without further knowledge of the picture exhibit to which you refer we can only suppose that the stereoscopic effect mentioned is caused by the side wise position of the head either shutting off the sight of one eye or in so far straining it that the sense of distance of the screen is lost the unconscious mental calculation by which distance is judged requiring the equal use of both eyes. We know of no mechanical attachment to a kinematograph or bioscope for producing the effect The lantern may have been at the back of the screen and the latter wet. The red lights in the New York post office to which you refer are Moore lamps, similar in principle to the Cooper Hewitt mercury vapor lamp, i e the light being caused by the vibrations set up in the passage of an electric current through a partial vacuum containing a residue of rarefied gas The gas in the Moore lamp is a secret mixture, probably containing mercury vapor and something else

(12126) E L B asks Please state in Notes and Queries the reason limestone is used in smelting iron ore A. Limestone is added to iron ore in the blast furnace because it is the most readily obtainable and cheapest flux. Iron ore consists generally of iron oxide mixed with a gangue or earthy matter which is most commonly siliceous. The silica is infusible by itself, but in contact with iron oxide at a high temperature combines readily into silicate of iron forming slag To prevent the great waste of iron which would result from the combination of the gangue with the metal of the ore it is necessary to provide a material with which the silica will readily unite forming a fusible slag substances thus added to take up the gangue of the ore and other impurities being known as fluxes Silica being acid requires a base such as lime and the slag formed is silicate of lime The use of fluxes constitutes one of the most important improvements ever introduced into the manufacture of iron, making it possible to reduce the metal from enormous quantities of lean ores containing as little as 25 per cent of metallic iron, whereas it was formerly unprofitable to treat ores containing much less than [illegible] per cent.

NEW BOOKS, ETC.

THE LIFE OF THE UNIVERSE AS CONCEIVED BY MAN FROM THE EARLIEST AGES TO THE PRESENT TIME. By Svante Arrhenius. Translated by Dr. H. Borns. Illustrated. Two volumes. London and New York Harper & Co., 1909. 16mo. Price, 75 cents.

The original title of this work reads in German Die Vorstellung vom Weltgebäude im Wandel der Zeiten " from which it would seem that Life of the Universe" hardly covers the subject matter, an impression which is furthermore borne out when it is considered that Arrhenius in this work is concerned not so much with the possibility of life on other worlds, but rather with the evolution of cosmical ideas. Dr Borns's translation (probably made from the German of Bamberger and not from the original Swedish) is not what might be termed idiomatic Many a Teutonism creeps in but on the whole he has given a very faithful English rendering. This latest excursion of Arrhenius s into the field of astronomy is practically without a counterpart in astronomical literature The histories of astronomy written by Delambre and by Berry are chronologies with critical comments rather than attempts at explaining the evolution of modern astronomical conceptions. Arrhenius traces the evolution of astronomical thought from the cosmogony of primitive races through the creation myths of the ancients, the philosophic systems of antiquity and the more scientific speculations of Copernicus and Kepler, until he arrives at the Laplacean nebular hypothesis and its modifications. If there is any truth in Haeckel's dictum that a true understanding of a science can be acquired only by a study of its evolution, then Arrhenius s book may be regarded as one of the most admirable astronomies ever written

HYDROELECTRIC DEVELOPMENTS AND ENGINEERING A Practical and Theoretical Treatise on the Development, Design, Construction, Equipment, and Operation of Hydroelectric Transmission Plants. By Frank Koester, Consulting Engineer, Assoc. Mem Am Inst. E E. Member Society German Engineers (Berlin) With 500 illustrations New York D Van Nostrand Company 4to, pp. 454 Price, $5 net.

In writing this volume it was the author's intention to present a comprehensive survey of the most advanced European and American practice in hydraulic engineering. In furtherance of that end he has given an admirable discussion of air shafts and equalizing chambers in connection with pressure tunnels seam lass-welded flangeless, telescoping penstocks to facilitate shipment and to eliminate expansion joints siphon systems impulse wheels with draft tubes and movable water-saving nozzles compound turbines on a single shaft, the discharge of one being the supply of the other rapid and complete turbine tests, thirty thousand volt generators and efficient devices for protecting them against lightning novel combinations of single and three-phase generators, wagon-panel switchboard systems segregation and decentralization of switchboards, continuous water-flow grounders and horn gaps with micrometric setting and two-legged transmission towers and line-crossing protection. Inasmuch as it is not the object of the engineer as a designer of hydroelectric developments to design any particular machine, such as a turbine generator, transformer, and the like but to provide by selection, from the different makes, an assemblage of machines and devices, each designed to perform its particular function in the most economical manner, this volume may be regarded as a handbook which will enable him to have machines properly combined for the purpose of generating and transmitting electric current from water power on a satisfactory commercial basis.

AS OTHERS SEE US By John Graham Brooks. New York The Macmillan Company, 1909 8vo., 13 ill Price, cloth, $1 75

There are few of us who can fail to profit by a perusal of this "study of progress" such is the author's secondary title. The author explains that he began the study by chancing, while on a journey, upon a century old volume of the criticisms of America by an early traveler, which with all its limitations and errors, so much relieved the monotony of his own travels by observation of change and development since the days of the critic, that he determined to let some foreign critic be his guide on all his later journeys. The result is a painstaking comparison of practically all that has been written of America by visitors from abroad, and the extent to which they consider us worth recording may be judged from the excellent bibliography at the end of the book comprising some hundred volumes. Nothing could be more admirable than the persistent good nature with which the author refuses to be annoyed by the occasionally insulting comments of foreign visitors when their observations are based on ignorance or prejudice except his candid sincerity in refusing to accept from them exorbitant praise when [illegible] events also [illegible] many a [illegible] [illegible] as [illegible] or [illegible] [illegible] been just and impartial. The author's [illegible] is lucid and dignified, and in spite of the fragmentary nature of the subject, the book has more sustained interest than many a work of fiction with a continuous story.

OCEAN AND INLAND WATER TRANSPORTATION. By Emory R. Johnson, Ph.D. New York: D. Appleton & Co., 1909. 12mo., 395 pp. Price, $1.50 net.

Some months ago it gave us great pleasure to review Dr. Johnson's "American Railroad Transportation," a most fascinating and authoritative book, which we enjoyed reading from cover to cover When the attention of the whole country is devoted to water transportation, particularly inland waters, any book which deals with such transportation is of great interest. It therefore gives us great pleasure to make a brief mention of Dr Johnson's later volume, which is no less complete in itself than the work relating to railroads. It is a practical and exhaustive treatise on ocean and inland water as a means of transportation, its physical and economic limits, cost, tonnage, and location. The book contains interesting illustrations and valuable statistics, which gives the reader exactly the information for which he is searching. The book is a most readable one, and is an authoritative work on the subject.

INDIA, ITS LIFE AND THOUGHT By Dr. I P Jones. New York The Macmillan Company, 1909 8vo, 375 pp., fully illustrated with photographs. Price, $2 50

While the present unrest and political ferment in India are so much before the public the present work has an especial interest. The author's point of view is singularly sympathetic and unprejudiced, and while his book has no deliberate political aim and attempts to solve no vexed questions, it sheds a great deal of light upon the complexity of the problem of British government in India. Dr Jones's experience of India has been that of a Christian missionary and, since his attitude is affected by that capacity, his feeling treatment of his subject is remarkably free from religious prejudice The book is as attractive to the dilettante mental traveler as it is valuable to the ethnological or political student, and is yet adaptable to summer reading being as interesting wherever "dipped into" as to the continuous reader It is admirably illustrated with fine photographs, the subjects including, of course, the peerless Taj Mahal and many other less known but little less beautiful gems of Oriental art.

THE ENGINEERING INDEX FOR 1908 Compiled and published by the Engineering Magazine. New York 1909. 437 pp., large 8vo. Cloth, $2.

The present volume entirely lives up to the reputation of its predecessors as being the most complete, if not the only, index of all engineering literature, whether included in books, technical periodicals, or the journals and proceedings of the engineering societies. This latest volume brings the investigator down to the close of 1908, while the earlier parts enable searches such as occur in patent cases and the like to be prosecuted with a minimum of cost and delay In this book, as in the volume issued last year, the "classified" system of arranging the items is followed in place of the "strict alphabetic" order of the earlier volumes. In other words, the articles indexed are first grouped under the great divisions of engineering practice to which they belong—Civil, Mechanical, Electrical Mining, etc.—and under these again they are sub-grouped according to the recognized special divisions of each field. This is possibly one of the greatest services the index renders to its regular users. The monthly continuation of the index, from the close of 1908 is to be found in the successive issues of the Engineering Magazine.

THE PROPER DISTRIBUTION OF EXPENSE BURDEN By A. Hamilton Church. New York The Engineering Magazine, 1908. 16mo., 116 pp Price, $1.

The contents of this book, prepared originally for The Engineering Magazine, is a series of articles which at once took rank as a standard reference work on one of the most difficult questions of cost finding A constant demand for these numbers has led to the republishing of the entire group in book form. An accurate distribution of general expense is admittedly one of the most perplexing and yet one of the most important problems with which the manufacturer must deal. The simple yet thorough analyses conducted in this volume, and the clear common sense demonstration presented will furnish a reliable guide to the solution of highly complex conditions in factory economy The book is a most excellent one for all who are engaged in manufacturing.

THE COPPER HANDBOOK Eighth annual edition. By Horace J Stevens. Houghton, Mich Published by the compiler, 1909 8vo, 1,500 pp.; cloth. Price, $5.

This number of the now widely known annual, which circulates in every country that has postage, more than lives up to the reputation established by its predecessors. Whereas the Copper Handbook is principally known as a complete directory of the copper mines of [illegible] any [illegible] of that [illegible] great deal of more general interest. [illegible] is the principal chapter of 1,1[illegible] pages describing no less than 4,[illegible] mines [illegible] is [illegible] fascinating reading even to the layman, the descriptions of Calumet and Hecla, or Anaconda, for instance, being full of the romance of great industrial achievements and the conquest by American skill and enterprise of the fastnesses of nature. The book includes a glossary of mining terms and [illegible] with the most complete statistics of the industry, world's production of copper by countries and states, output of leading mines, variation of prices, share-holding and dividends of companies, etc. The compiler shows his confidence in the value of his work by sending it anywhere, charges prepaid, allowing a week's inspection and return of the book if not found acceptable.

HOW TO APPRECIATE PRINTS. By Frank Weitenkampf. New York Moffat Yard & Co., 1908. 12mo., 333 pp. Price, $1.50 net.

Mr. Weitenkampf is the curator of the print department of the New York Public Library, and there is no better connoisseur in the world than he. His knowledge of prints and kindred material is at the disposal of all who are in any way interested in the subject. The Lenox Library, where the prints are kept at the present time, is a Mecca for students, who are directed to the proper source of material by Mr Weitenkampf. This qualifies him to produce a very valuable treatise, which it gives us great pleasure to review. The first chapter deals with "The Taste for Prints"; then comes a chapter on "Etchings" then one on "Line Engraving" "Mezzo-tints"; "Tint Methods", "Stipple and Other 'Dot' Methods"; "Wood Engraving", "Lithography", "The Photo-mechanical Process", "Color Prints", "Coloring"; "The Making of Prints", and "Certain Minor Information." The book is admirably written and shows a broad and catholic appreciation of the entire subject. We have not seen such a good book on prints for many years. We congratulate Mr Weitenkampf on the production of such an excellent book.

ELECTRIC RAILWAY POWER STATIONS. By C. F Swingle Chicago F J Drake & Co., 1909 8vo., 720 pp., fully illustrated with photos and diagrams. Price, $2.50

In this work the author attempts to include all that it is necessary for a central station engineer to know about boilers, mechanical stokers, steam engines, both turbine and reciprocating, gas engines of all kinds, pumps and auxiliaries of all kinds, dynamos, motors and switchboard instruments of every description. If this ambition were attained with complete success the book could hardly be so portable. It is possible that there may be central stations which include both gas engines, reciprocating steam engines and turbines, and operating engineers who desire all those machines described in one book, but we should say that any engineer who did not know as much of the contents of this book as applied to his particular work would prefer to learn it from separate books on the different subjects with space enough to treat them thoroughly Questions and answers are interspersed through the book with no particular reference to the text, an examination on slide-valve setting appearing, for instance, at the end of a chapter on steam turbines. The illustrations are apparently taken principally from manufacturers' catalogues, and being photographs of half-tones does not add to their clearness. As a whole, at a time when more than ever it may be said that "of the making of many books there is no end," this work appears to us to fall naturally into the harmless but unnecessary class.

HINTS ON HOUSE FURNISHING. By W Shaw Sparrow. New York: John Lane Company, 1909. 8vo.; 308 pp. Price, $3 net.

The sumptuous volume before us is filled with valuable hints on house furnishing and decoration. The plates are particularly well executed and are inserted, allowing the text to be printed on paper which is agreeable to the eye and to the fingers as well. After a general introduction which covers the subject in an admirable manner, the walls and their treatment are taken up, followed by the floors and their treatment, then come the ceiling, the windows, blinds, and curtains. A chapter on textile fabrics follows, and there is an interesting chapter on artificial heat and light. Then the furnishings of the house are treated. Crockery and porcelain are treated in the next chapter, and then comes a chapter on furniture and sanitary appliances. There are also chapters which give valuable hints on rooms for various uses. There is even a section on that much-neglected subject—garden furniture. It is a beautiful book which is worthy of a large sale.

THE AUTOBIOGRAPHY OF NATHANIEL SOUTHGATE SHALER. With a Supplementary Memoir by His Wife. With illustrations. Boston and New York The Houghton Mifflin Company, 1909. 8vo., pp. 481, Price, $4

In the annals of Harvard University it would be difficult, indeed, to find a man who [illegible] so far reaching an influence upon the [illegible] body at large, as well as upon [illegible] of the faculty with [illegible]

[illegible] on the late Prof. Shaler. [illegible] of his wonderful personality undoubtedly was the most public is probably those interested in his scientific attainments as a geologist. His special studies of oceanic [illegible], volcanoes, glaciology, and lunar geology are probably the works upon which his scientific reputation is most firmly seated. It is unnecessary for us to dwell upon that work here, largely because its merit was recognized in his lifetime. The autobiography before us is a charmingly written, unaffected statement of a career carefully molded from childhood, and replete with incidents that have not a little human value, inasmuch as Prof Shaler during his long life met most of the celebrities who have ever reached Cambridge and Boston, and noted his impressions of them. The autobiography is a record of lifelong efforts to interpret the facts and mysteries of nature upon which Prof. Shaler so lovingly pondered.

Cooking for Two. By Jeanette M Hill Boston Little, Brown & Co, 1909 12mo., 407 pp. Price, $1.50 net

This is a handbook for young housekeepers, and is designed to give cheaply and simply and in concise form those things which are essential for the proper selection and proportion of a reasonable variety of food for a family of two. Of course, by doubling the quantity of each ingredient, enough can be prepared for four or five people. The food products considered in the receipts are such as a housekeeper of average means would use on every-day occasions, with a general sprinkling of choicer articles for Sunday. Menus for a week or two in each month are given. The receipts are given with special attention to clearness of expression. The illustrations are particularly valuable. In many cases they show the *modus operandi* and proportions, or else the raw materials and the various steps. The half tones are beautifully executed and they are well printed. We have not seen any cook book for a long time which compares favorably with this one.

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Sheet feeding mechanism B Gustafson	934 [illegible]
Sheet metal blanks machine for feeding A Slayman Jr	934 848
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Steam and liquid separator C F Hylander	934 727
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Stone manufacturing artificial A Braun	934 710
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Store front connection E. S. Rhoads	934 [illegible]
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Fertilizer distributer J H Bloom	935,579
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(*Continued from page 256*)

pictures are taken and projected intermittently, the shutter both in the camera and projector being a sector having an area approximately one-seventh of the area of a circle. While the shutter is closed the film is jerked forward by an interval equal to the height of a single picture on the film. In the Friese-Greene apparatus, however, a continuous picture is secured, since the operation of the twin lenses is alternating that is to say while one is closed the other is open. Consequently although the separate films carry images intermittently recorded, the one secures those which the other lost during the short space of time its lens was closed by the shutter

In regard to the arrangement of the color filter and its manipulation a highly important development has been effected The color filters are disposed on an endless band of transparent celluloid in the order of red green, and blue. Each filter is of the same size as the cinematographic image on its film namely, ¾ inch deep by the standard width, and like the latter is perforated along its edges so that the movement of the color filter and sensitized films are synchronous and the two being kept in dead juxtaposition By reducing the thickness of the color filter medium to the infinitesimal proportions of a thin celluloid band all troubles concerning light refraction and reflection are completely overcome.

By reference to the accompanying illustration showing the interior of one side of the stereoscopic camera, its operation may be clearly understood, as well as the disposition of the color filter band Starting from the point *A*, which is a pulley, the color filter band passes to and over the jockey pulley *B* thence around the drum *C* where it picks up the unexposed sensitized film issuing from the unexposed film spool box at the top on the right, and is superimposed on the sensitized surface of the film The color filter and film are now caught with their respective edge perforations in dead register, and carried down through a guide channel *D* to the point of exposure behind the lens As the shutter is closed the oscillating twin pronged arm *E* falls and the teeth engaging with the perforations of the two superimposed films pulls them down together over the lens for a distance of three-quarters of an inch—the height of a cinematograph picture—and holds them firmly there during exposure This completed the turning of the driving handle raises the pronged oscillating arm *E* so that the films are released, and the arm rising in its travel falls and grips the films, once more jerking them down another three-quarters of an inch over the lens aperture This cycle of operations is repeated while exposures are being made, successive filters and corresponding sections of sensitized film being brought forward in this manner

As the exposed film surface and its color filter pass away from the lens they travel together over another jockey pulley and drum *F*, after which the two separate, the exposed film passing over the pulley *G* and entering the exposed film box, where it is wound on the spool in the usual manner while the color filter band travels over the pulley *H* along the base board of the camera under the guide pulley *I*, up the back of the apparatus over pulley *J* and along the top to pulley *A* and *B* to *C* where it picks up the sensitized film once more. The same cycle of operations is repeated during the period exposures are being made.

The second half of the camera is precisely the same in construction and operation as the first half. There is one important difference in the disposition of the color filter band in regard to its exposure, relatively to that in the other half of the camera. A blue instead of a red screen passes before the second lens aperture synchronously with that before the first lens. The effect is that in the course of the exposures there is a continual cutting off of the respective colors. That is to say, when red is exposed for the first lens, it is immediately succeeded by the blue in the second lens, followed in turn by green in the first lens, the latter then being cut off by the red in the second lens, then blue in the first, succeeded by green in the second lens, and so on The accompanying diagram will best illustrate how the successive cutting off of the colors is effected

Another notable point is that the inventor does not require three separate negatives taken through the red green and blue color filters respectively and then similarly superimposing their transparencies through relative color filters to secure the three-color effect. Such is the process generally followed in accordance with the Ives system of still life color photography By this last named process the film would obviously have to be three times the length of the monochrome record, in order to secure the three fundamental negatives and would need to be projected at three times the speed to secure the desired effect Mr Friese-Greene, however, has ascertained that in chromo-photography such a process is unnecessary when carried out upon his lines and that the continual cutting in and out of the colors will enable them to be blended so easily and rapidly that the brain sees the heliochromic image only

It will be realized from a study of the shutter arrangements in the accompanying illustration that each lens is insured an equal period of exposure The shutter area is exactly one-half of that of a complete circle and as one lens aperture is being cut off the other is being cut in which materially assists in the blending of the colors through their respective filters, there being an entire absence, from the eye point of view of any sharp line of demarcation The sighting and focusing of the camera follow the usual practice in such cinematographic apparatus, as does also the method of operation for taking photographs though certain improvements have been incorporated The camera itself is practically the same size as that of the single-lens instrument, everything being rendered as compact as possible

The projector follows the lines of the ordinary instrument for this purpose with the exception that there are two lenses placed side by side Here again the exposure is intermittent The two lenses are each fitted with a micrometer screw so that their angle to one another can be adjusted to a nicety and varied according to the size of picture projected, which of course is relative to the distance of the screen from the projector The facilities whereby the angle of the lenses to one another is adjusted insures that irrespective of the size of the image exact superimposition of the two pictures projected from the twin lenses is absolutely certain upon the same given area.

In the projector two similar endless color filter bands have to be used Their arrangement is very similar to that adopted in the camera and suitable devices are employed for keeping them in absolute register with the picture film It is quite impossible, therefore, for any difference in register upon the screen or confusion of color filter and its relative picture to result. Moreover, there is the same relationship in regard to the cutting in and out of the respective color filters to secure the desired blending of the colors, so as to insure in conformity with the phenomenon of visual persistence the impression of a perfect three color image being conveyed to the brain This result is also assisted by the fact that projection is really carried out at twice the usual speed, thirty-two pictures being thrown on the screen in the course of a second from the two lenses—sixteen from each. Owing to the perfect superimposition of the pictures from the

(*Continued on page 270*)

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two lenses upon the white wall [illegible] able clearness and definition are obtained, the color beauty of the image being appreciably enhanced by the stereoscopic effect which is produced. As also the two pictures depict continuous motion there is an entire absence of flickering due to the shutter, the effect being practically the same as if one were resorting to the camera obscura.

In order to secure the requisite stereoscopic effect in projection the apparatus for this purpose has necessarily to be of special design. Its general characteristics are plainly shown in the accompanying photographs (Figs. 4 and 5). There is the lantern body for carrying two illuminants, one for each lens. The lenses themselves are rendered angularly adjustable by means of a micrometer screw so that in stereoscopic work the two images may be exactly superimposed upon the screen and yet at the same time rendering it feasible to use the apparatus for ordinary work by cutting one-half of the lantern out of service.

The operating mechanism while broadly following that of the ordinary single projector is simpler. The feed spools are carried on a common axle at the top and the films lead down to their respective lines of travel through the gateway behind each lens, subsequently being wound up on the lower spools, these working synchronously through a central spring pulley drive.

Color projection can be effected either by a revolving disk carrying three equal sized sectors of red, green and blue glass respectively, the cutting in and out of each color being precisely the same as in the camera. That is to say while one lens is being uncovered the other is being closed, so that in reality the image from one lens is being thrown on the screen at one time instead of the two exposures being made simultaneously as in ordinary stereoscopic practice. It is the speed with which projection is made and the cutting in and out of the colors on each lens—about 5 per second—that in accordance with the peculiar law of visual persistence yields not only the natural color but also the stereoscopic effects.

Though the rotating disk is the simplest means of projection, the color effects are not technically correct nor so beautiful as are produced by the endless traveling band composed of small color screens, red, green and blue successively. This is attributable to two factors. In the first place as the rotating disk is placed in front of the lens there is a certain distance through which uncolored light travels—that is between the film and the color screen—and in projection there is a tendency toward jumbling of the three colors into the white light. On the other hand when the color screen is in immediate juxtaposition with the film no white light whatever is projected.

The apparatus shown in the accompanying illustrations is applicable to either disk or endless band operation. If the band is used it is only necessary to withdraw the colored screen sectors from the revolving shutter, which is readily effected by means of clips which hold the screens in position, the three remaining opaque sectors acting as the cut-off between each successive color filter and its picture on the band. The band itself is carried over a jockey pulley and sprocket drum at the top of the projecting mechanism and carried down through the gateway with the transparent film against which it is tightly held during the instant of projection. Issuing from the gateway it passes over a lower sprocket drum and jockey pulley where it leaves the picture film which is wound on the spool below, the color band passing over a rigid horizontal arm shown in the illustration set at an angle of about 45 deg. so that the upward traveling part may clear the field of the lens, passing over another similar angular arm at the top which deviates it

(Concluded on page 271)

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once more over the top sprocket drum and pulley where it meets the picture film traveling from the upper spool and the operation is repeated

The grave disadvantage of the revolving disk is that the screens therewith have to be as it were standardized that is to say, must be such that they are equally applicable to any picture that may be used in projection irrespective of the densities of the color filters used in photographing This often destroys or depreciates the true color effects and values On the other hand with the band it is possible to secure the same relative color screens that were used in taking the picture so that the latter is virtually projected through the same color filters as were employed for photographing

With the band moreover a new film can be far more easily fed into the machine In this apparatus the gateway is of special design The picture film has a short length of lead indicating successively red green blue in the order in which the exposures are made All that is necessary to do is to open the gateway superimpose the one color filter of the endless band upon its corresponding indication upon the lead and then all is ready for projection The apparatus has been demonstrated in London and Paris and the possibilities of the Friese Greene system owing to its simplicity and economy combined with truthfulness of color value and density have attracted considerable attention

◆

THE VISITING WARSHIPS—A COMPARISON

(*Continued from page [illegible].*)

point of bearing is most advantageous for her batteries and least advantageous for those of the enemy

Now from what we have said above it will be evident that when an all big gun ship meets one that carries a mixed armament of big guns and guns of medium caliber she will endeavor to place herself at sufficient distance from the enemy to be outside of the armor piercing range of its medium-caliber guns and within the armor piercing range of her own big guns She can only do this however by possessing a reasonable superiority of speed and the greater her excess of speed the more completely will she be master of the position

Applying these facts to the Connecticut Justice and Inflexible we can see at once how completely the all big gun high speed fighting ship of to-day outclasses the big and medium gun moderate speed battleship of the pre Dreadnought period The big gun ship is vitally vulnerable only by the penetration of her waterline or of the barbettes and turrets in which the 12 inch guns are mounted The greater part of the personnel of the pre- Dreadnought battleship on the other hand is stationed at the numerous guns of the secondary battery where they are protected by comparatively light armor and even at the fighting range of five miles they would be exposed to complete destruction by the high explosive 12 inch shells

Gun Power.—Comparing the three ships on the basis of gun power we find that the Connecticut carries four 12 inch 45-caliber guns eight 8 inch 45 caliber guns and twelve 7 inch 50 caliber guns the Justice mounts four 12 inch 50-caliber guns and ten 7 6 inch 45 caliber pieces while the British Inflexible' mounts eight 12 inch 45-caliber guns but no secondary armament Now at a fighting range of five miles the 12 inch gun of the Connecticut firing an 850 pound shell at 2 700 feet per second velocity can penetrate 8 inches of Krupp armor the 12-inch gun of the Justice firing a 731 pound shell with a muzzle velocity of 3,000 feet per second, can penetrate 7 inches of Krupp armor, and the 12 inch gun of the 'Inflexible," firing an 850-pound shell at 2,900 feet per second, at the same range can penetrate 9 inches Now, since the belt armor of the "Connecticut" varies from 11 inches amidships to 4 inches at the ends and that of the 'Justice varies from 11 inches to 5½ inches at the ends it follows that the vitals of both these ships would be quite secure against the attack of the Inflexible at this range although it would be possible for her to penetrate both ships at each end of the waterline Since the 12 inch guns of both the Connecticut and the Justice are protected by from 10 to 12½ inches of steel they should be practically safe against penetration On the other hand the Inflexible would not fare so well since her belt protection varies from 7 inches amidships to 4 inches at the ends and she would be theoretically penetrable by the guns of both her opponents at five miles range Her 12 inch guns however with a turret and barbette protection of 10 inches armor would be secure against penetration

It should be borne in mind however that these figures of penetration are worked out for impact *at right angles to the armor* At these distant ranges the projectiles would be falling at an angle of several degrees and therefore the resisting power of the armor on all three ships would be considerably higher than that mentioned above

The secondary armament both of the Connecticut and the Justice could riddle the unarmored but could not penetrate the armored portions of the Inflexible whereas the turrets and casements in which this secondary armament is mounted could be completely destroyed by the Inflexible's guns Thus for the 8 inch of the Connecticut to penetrate the 7 inch belt of the Inflexible they would have to be within 5 400 yards of that ship, and the 7 inch battery would have to be within 4 000 yards while the 7 6 inch gun of the Justice would have to be within 7 000 yards to effect penetration at normal impact On the other hand the 6 inch and 7 inch armor which protects the secondary battery of the Connecticut and the ½ inch and 4 inch armor on the turrets and bases of the secondary battery of the French ship would be at the mercy of the Inflexible's 12 inch guns

In this supposititious engagement to show the advantages of the Dreadnought type of battleship over the type with the mixed armament the Inflexible with an advantage of 6 to 8 knots of trial speed (it will be understood of course that an engagement would never be fought at these maximum speeds) would elect to place herself at the maximum effective range for her own guns which if the weather were clear would probably be not less than five miles Her higher speed would give her the same advantage which the weather gage or windward position gave to the old fighting frigates in the days of sail power and the smoothbore Her probable plan of attack would be to assume a position somewhat ahead of the leading ship and then concentrate the whole of her eight guns upon that vessel in the endeavor to cripple each ship in detail and it is an interesting question whether this concentration of fire on each ship in turn coupled with the vulnerability of the armored positions of the secondary batteries and the great exposure of the crews of those batteries would not go far to offset the lighter armor protection of the Inflexible By taking skillful advantage of her superior speed and if the gunnery on all three ships were equal it is conceivable that she might win the fight. Should she be getting the worst of it on the other hand her higher speed would leave her free to draw out of the conflict whenever her commander saw fit From what we have said however it is evident that ship for ship she would be more than a match for either vessel alone and in a duel she would probably close in to 6 000 or 7 000 yards and try to overwhelm the enemy quickly with her 12 inch guns.

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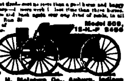

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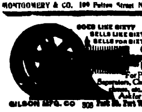

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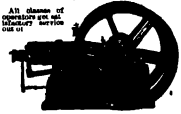

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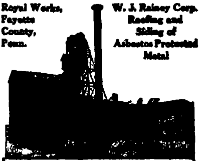

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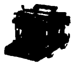

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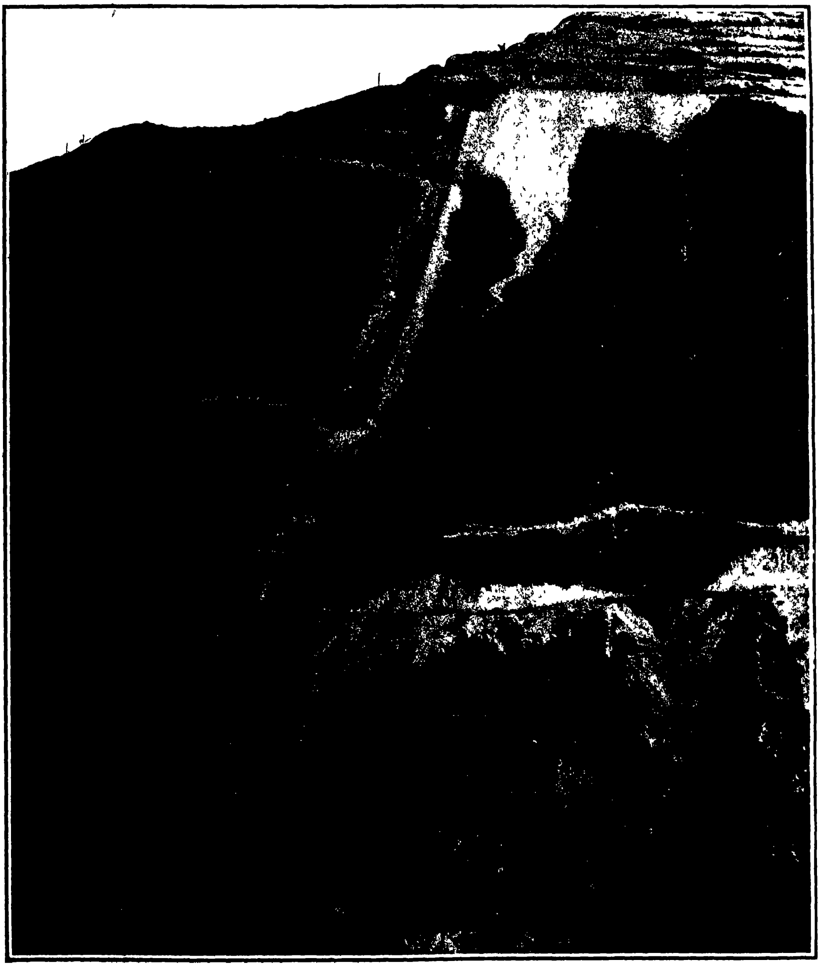

The inclined tramway by which the mountain top, removed by steam shovels, is sent down to the mill.

MOVING A MOUNTAIN IN UTAH.—[See page 281.]

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NEW YORK SATURDAY OCTOBER 16th, 1909

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short* and the facts *authentic*, the contributions will receive special attention Accepted articles will be paid for at regular space rates

EDUCATIONAL VALUE OF THE HUDSON-FULTON CELEBRATION

In view of the considerable cost exceeding $1 000 000 of the Hudson Fulton Celebration, the question has been raised as to whether any results have been realized or could possibly be realized that justify so great an outlay If by results we are to understand any tangible commercial returns, it might be difficult to give a satisfactory answer although it cannot be doubted that mine host of the inn and that innumerable army which caters to the physical well being of a holiday crowd are more than satisfied

To those of us who are in the habit of looking below the surface of things and who ever bear in mind the transcendent importance of the spiritual and moral over the merely material, it will be evident that the mere outlay upon the recent festival is of minor importance compared with the valuable gain to New York city, the Hudson River district and to the country at large due to the close attention which that festival has directed to certain important events in the history of the United States and the correcting of certain serious historical errors concerning them

Thus, in view of the far-reaching importance of his discovery, it was well worth the cost and trouble of the celebration to abolish once and for all the myth ical Hendrik' Hudson and have restored to the page of history the actual Henry Hudson Englishman," who sailed in a Dutch ship and under the Dutch flag after signing the recently discovered contract in which he is so named and thus designated And it may be as well just here to explain that the total absence of the English flag from the elaborate scheme of decoration was perfectly proper even in spite of the fact that it celebrated the feat of a British citizen For the discovery of the river was made under the auspices of a Dutch company and by a ship which flew the blue white and orange just as that other great event commemorated by the celebration the inauguration of steamship travel was achieved by a vessel which flew the American flag Technically considered the exclusive use of the old Netherland colors and of our national emblem was correct and had the scheme of decorations been thrown open to include the flags of all nations it would certainly have lost much of that distinctive character which was one of its successful features. Now that the historical facts as to the real name and nationality of Hudson have been presented in such convincing form to the world at large, it is to be hoped that the mistaken spelling of the name will be carefully avoided in the interests of historical accuracy

The other important truth brought out by the recent festival is the true relation of Verrazzano and Henry Hudson to the discovery of the Hudson River The name of Hudson has been given to the river by practically universal consent because he was the first navigator to make a complete exploration of the river throughout its navigable length and to leave behind him a careful record of what he saw and did He did not himself claim nor as far as we know has anyone claimed that he was the discoverer of New York Bay an honor which we think should rightly belong to Verrazzano The document which gives the account of Verrazzano's visit to New York Bay leaves the impression that his time was spent in the bay and that the river he mentioned may have been the Narrows Certain it is that the fact that the water at the mouth of the Hudson if he ever entered that stream was completely salt, and that the tidal currents were as strong in one direction as the other, must have given Verrazzano every reason to believe that he was at the mouth, not of a river, but of an arm of the sea. Verrazzano was a bold navigator, and his letter to Francis the First, describing his voyage, proves him to have been a close observer and capable of giving an entertaining description of what he saw The genuineness of the letter, it is true, has been attacked, but the latest consensus of opinion among the historical authorities agrees to consider it as genuine.

For those reasons it is rather timely that the Italians of this city should have recently erected a monument to their fellow countryman, which will serve to connect his name with the famous harbor into which he sailed in 1524

EVOLUTION NOT REVOLUTION

We have received so many requests for information about the widely discussed Melville-MacAlpine improvement in the marine steam turbine, and so many exaggerated statements have appeared in the public press as to the "revolutionary" character of this device, that we hasten to say the improvement is in no sense revolutionary but is rather one important step in the evolution of the ideal marine turbine drive Hitherto the propeller has been placed on the same shaft as the rotor or rotating portion of the turbine. In the device which Westinghouse has built for Melville and MacAlpine the propeller would be placed on a separate shaft from the turbine and a reduction gear of five to one interposed between the shafts, thereby reducing the speed of the propeller to one-fifth that of the turbine

Why is this improvement, supposing that in actual test at sea it proves to be as efficient as in the experimental tests of such great importance? Why should not the turbine and propeller be upon the same shaft? Why should it be desirable to run one at a much higher speed than the other? The answer is that the steam turbine shows its best economy consumes the least coal per horse-power when it is run at high speed whereas the propeller shows its best economy when it is run at a relatively low speed of revolution This is true both of high speed transatlantic steamships and slow-speed cargo boats The propellers of the "Kaiser Wilhelm II," running at a speed of 85 to 90 revolutions per minute show a propeller efficiency of from 60 to 65 per cent. The propellers of the "Lusitania," running on her trial trip at 180 revolutions per minute showed a propeller efficiency of only 48 per cent. Had the 'Lusitania" used larger propellers running at lower speed the speed of the turbine would have been too low for efficiency and results at the turbine end of the shaft would have been disastrous. On the other hand had turbines been used on the "Lusitania" running at the high speed which gives a maximum turbine efficiency the propeller efficiency would have been even less than the low figure of 48 per cent. The only way out of the dilemma was to use the present speed of 180 revolutions which is too low for the best turbine results and too high for the best propeller results.

Now, what Melville and his coadjutors have done is to design a gear which is strong enough and runs with sufficient sweetness to transmit the great horsepower of a modern steam turbine without causing excessive loss by friction When De Laval introduced the first practical steam turbine some fifteen years ago, he solved the problem by introducing a long helical gear which reduced the speed from the several thousand revolutions per minute of the turbine to the working speed which was required on the power shaft. Apparently what has been done in the new device is to master the difficult problem of providing a helical gear with a certain power of automatic self-adjustment which will enable it to transmit several thousand horse-power without serious wear or heavy loss through friction

Henceforth if the gear shows good results in service at sea it will be possible to secure the same horsepower with smaller turbines running at high speed, and to design the propeller with strict reference to the size and speed of the ship and the securing of a maximum effective thrust. Economy will thus be effected at both ends of the shaft, the engine room will become smaller, engine weights less, and the space and weight thus saved can be put into cargo and passenger space, or, in a warship, into heavier armament and better protection.

THE MOST POWERFUL NAVAL GUN.

In a certain respect big guns are like big battleships. At the time they are being built, it would seem that the limit of size and range had been reached, as indeed they have, for the time being. The progress toward improvement is so rapid, however, in these days, that hardly has one construction reached its supposed limit, before work is begun on another, bigger and better A good illustration of this fact is had in the making of the largest and most powerful naval weapon in the world, namely, our new naval 14-inch breech-loading gun. This powerful weapon is nearing completion, and will be delivered to the Navy Department by the middle of October, for [illegible] tests at the Indian Head proving grounds.

The penetration of the new 50-caliber 14-inch guns to be installed on the new 26,000-ton battleships of the "Arkansas" class is given, at 11 inches of Krupp steel at an extreme battle range of 9,000 yards. The thickness of the armor plate on the British battleship "Dreadnought" and her successors in the British navy is 11 inches at the maximum This thickness of armor is being used on the new American warships now under construction. Up to the time of the construction of the 14-inch gun, the new American 12-inch gun, with its penetration of 11 inches of Krupp armor at 9,000 yards, was our most powerful gun But that it has been greatly surpassed by the new piece is shown by the following figures

The new 14-inch gun weighs nearly 64 tons, or 10 tons more than the 12-inch rifles built for the battleships "North Dakota" and "Delaware." Its total length is 53½ feet. The capacity of the powder chamber is 15,848 cubic inches, and it will require 365 pounds of smokeless powder to hurl the projectile of 1 400 pounds. After this huge shell is fired, it will travel a distance of 542 inches within the bore of the gun, and after leaving the muzzle it is good for a 25-mile flight. The range at which it would be fired in actual battle however would be about 9,000 yards, or five miles. The range of naval battles has trebled since the Spanish-American war, at which time 3 000 yards was the estimated range for a naval conflict, the guns being built accordingly But now to outrange the "enemy" it has become necessary to build all American naval guns with a range of five miles.'

The shell will leave the muzzle of the 14-inch gun at the rate of 2,600 feet per second, and its muzzle energy will be 65 606 foot tons. This is 12,000 more foot tons energy than that designed for the latest 12-inch weapon. So great is the penetrative power of this rifle that, when fired with a full charge, the projectile will penetrate 22 7 inches of the best Krupp steel armor plate at the muzzle, and at the range of 9 000 yards would pass right through a piece of armor 13 inches in thickness

THE RECORD FLIGHTS OF ORVILLE AND WILBUR WRIGHT

Almost simultaneously in Germany and in America Messrs Orville and Wilbur Wright made two new records of an entirely different kind on the second and fourth instant The first record was made by Orville Wright at Potsdam Germany on October 2nd He first took Crown Prince Frederick William on a flight of 10 minutes' duration at about 4 30 in the afternoon During this flight the machine was driven to an altitude of about sixty feet The Crown Prince was greatly pleased and he urged Mr Wright to go higher Soon after alighting Orville Wright started out again by himself and for fifteen minutes he kept steadily mounting in circles until the areoplane was a tiny speck in the sky After reaching the maximum height, which he estimated was about 500 meters (1 637 feet) he started in a swift descent The machine came down at a terrific rate and finally alighted safely about five minutes after it started the descent. Orville Wright said that the view he obtained was very similar to that he had when on board the Zeppelin airship, except that objects seemed smaller on account of his greater height. The height reached was not accurately measured, but from Wilbur Wright's statement to our editor that his aeroplane, if sent upward at its best speed, would probably ascend at the rate of three feet a second, it seems probable that Orville attained even a greater height than he believes himself to have reached.

The second record is that of Wilbur Wright, which was made about 10 A M. on the morning of October 4th, when he started from Governor's Island and flew over the waters of New York Bay and above the North River to a point opposite Grant's Tomb. Circling around the British cruiser "Inflexible," he made the return trip close to the Jersey shore, at an elevation of only about seventy-five feet. On the upward journey he flew at a height of some two hundred feet, where he experienced considerable difficulty from the eddies and gusts of wind produced by the skyscrapers in the lower part of the city A northeast wind of about twelve miles an hour velocity was blowing. On the return trip, the daring aviator kept on the other side of the river, and at a low elevation in order to avoid these gusts The entire journey was made in 33 minutes and 33 seconds the distance being about 19½ miles. This flight was not official, and Mr Wright expected to repeat it in the afternoon The weather conditions were ideal at 4 P M., but just as he was about to start a cylinder blew off the motor, and effectively put the machine out of commission. As Mr Curtiss had left the city the evening before after having made a short circular flight of a quarter of a mile, there was no more flying in connection with the Hudson-Fulton Celebration. Mr Wright has already begun to teach two lieutenants to fly the government aeroplane.

ENGINEERING.

Steel manufacture by the electric furnace is making good headway At the present time there are in operation about 89 furnaces of the electric type, namely, 19 of the Héroult system, 14 of the Kjelling, 10 of the Stassano, and the same number of the Roechling-Rodenhauser and Girol, the other twenty-seven furnaces being of eight other systems.

During the Hudson-Fulton Celebration week, the Interborough Rapid Transit Company of this city carried in the course of one day 2,200,060 persons without accidents, blocks, or other detriment to its service The traffic was about equally divided between the elevated roads and the subway Considering the crowded condition, this is a truly marvelous feat of city transportation

At last the Atlantic has been crossed by a steamship at a speed of over 26 knots an hour the "Mauretania" on her last trip to the westward having covered the course from land to land in 4 days, 10 hours, and 51 minutes, at an average of 26 06 knots, reducing her last record trip to the westward by 44 minutes Although she did not reach her highest previous day's run, she maintained a steady high speed on every day throughout the course.

The monthly report of the Acting Chairman of the Panama Canal to the Secretary of War dated September 15th, states that during the month of August the total amount of excavation done on the Panama Canal was 2 755,178 cubic yards, the average rainfall being 9 27 inches. From now on there may be a diminution in the totals of excavation, due to the fact that portions of the canal have been finished and that as the excavation grows deeper, the number of shovels that can be employed will be reduced

The tests which are about to be made of the new army 14 inch gun at Sandy Hook will be followed with close interest, for upon the success of this gun will depend the character of the future armament of our sea-coast defenses. The new piece weighs about the same as the present 12 inch gun but fires a heavier projectile with lower velocity and a greater curve of trajectory Its great advantage is that it can fire 250 to 300 rounds without serious erosion as compared with the limit of 80 to 85 rounds for the 12-inch gun

The Bath Iron Works are to be congratulated on the remarkable speed made by the new torpedo-boat destroyer 'Reid" during her standardization trials on the Rockland mile course, when she reached a maximum speed for one mile of 34 55 knots. This is about a knot faster than the speed, which was itself a record for a torpedo-boat destroyer of the "Flusser' which made over 33½ knots The mean of the high-speed runs of the 'Reid" was 33 75 knots which is an eighth of a knot better than the average of the "Flusser" The shaft horse power was 15,000

The Japanese armored cruiser "Ibuki" which is equipped with the Curtis reversible turbine built by the Fore River Company has recently undergone successful steaming trials in Japan In the six-hour trial under full power, the steam chest pressure was 239 pounds, and the exhaust shell vacuum was 25 7 inches. At 250 5 revolutions per minute the brake horse-power was 27,142, and the water rate per brake horse-power was 15 03, corrected to contract conditions, it was 13 88 pounds. The "Ibuki" carries four 12-inch and eight 8-inch guns

The consulting engineer appointed by the city to pass on the plans and safety of the new Manhattan Suspension Bridge Mr Ralph Modjeski has found everything to be satisfactory The main tower foundations are good and sufficient, and although the foundation of the anchorages could have been improved by driving inclined piles, the fact that careful observation for the past sixty days failed to reveal any appreciable movement, leads him to consider that the foundations are safe and sufficient. The structure has been carefully designed and well built and will be amply strong to carry the heaviest traffic, as well as any reasonable addition in the weight of properly regulated traffic that it may have to carry for many years to come.

One of the most important works connected with the Panama Canal is the spillway in the middle of the Gatun Dam for regulating the height of the water in the lake. Usually it is preferred to locate the spillway in a position more or less remote from the dam, but in the present case the existence at the center of the site of the dam of a hill, which provided a rock surface at about sea level, proved the deciding factor, and led to the choice of the present site The spillway consists of a concrete dam, whose crest is to be built on the arc of a circle, with its face convex to the lake. The crest will be at 69 feet above sea level. Above this, and placed between thirteen concrete piers built at the crest of the dam, will be fourteen gates, whose tops, when they are closed, will be 87 feet above sea level. These gates will give absolute control of the lake level under all possible conditions.

ELECTRICITY

The Postmaster-General of the United Kingdom has secured for the government telegraphic system all the Marconi wireless telegraph stations in the British Isles.

A new combined electric lamp and shaving mirror has been produced, in which the reflector can be arranged to throw the light only upon the face below the eyes, no light falling upon the mirror or the eyes.

The British Antarctic expedition now in course of preparation will carry wireless telegraphic equipment sufficient to enable messages to be sent to New Zealand from the ship and from stations established at bases of supplies on land or ice

The Russia crown steel works at Slatons in the Ural district have secured the right to manufacture steel electrically by a process owned by a German company and using induction furnaces An electric plant will be immediately installed by the Siemens-Halske Company, and the product will be marketed directly

The electrified suburban system of the New South Wales State Tramways at Sydney, N S. W, showed a profit of $357 000 for the year ending June 30th 1908, after paying all working expenses and interest on capital as compared with a net loss of $15,500 a year for the steam lines owned by the State This encouraging result will probably cause extensive electrification in Victoria and other adjoining States.

The Commonwealth Edison Company of Chicago has been most successful with its plan of introducing electric flatirons Ten thousand 6 pound irons were distributed up to March last on loan for six months without charge At the end of that period the used irons were offered for sale at a reduced rate to the users most of whom were only too glad to retain the irons at so low a price while the demand for used irons returned has been greater than the company can supply

It is reported that a large wireless telegraph and telephone station is to be erected at the Omaha shops of the Union Pacific Railroad where Dr Frederick H Millener will conduct wireless telegraph and telephone experiments. Dr Millener hopes to develop wireless telephony to such an extent as to permit railroad officials to keep in touch with trains and thus govern their movements from sixty to one hundred miles from Omaha If the system is developed as he expects it will be possible for passengers on moving trains to carry on telephonic conversation within a radius of one hundred miles of Omaha

The rapid progress of aviation has caused attention to be drawn from a new direction to the dangers of atmospheric electricity In an article in the Elektrotechnische Zeitschrift Mr L Zehnder discusses the danger to balloons and aeroplanes of electrical disturbances and the methods of avoiding disastrous effects. He points out that the electrical conditions of the air are subject to great variations during thunder storms and that the atmospheric charges may change suddenly in sign In clear weather an ordinary balloon without metal parts is not exposed to any danger so long as it floats in the air but in the modern dirigibles much of the framework consists of conducting materials, which add to the danger Also a balloon may be charged with electricity and a spark produced when contact with the ground is made, setting fire to the gas

An ordinance was introduced at a meeting of the City Council of Chicago making it compulsory for all railroads operating within eight miles of the city hall to use electricity on their lines in place of steam There is every prospect that this ordinance will be passed as there appears to be considerable popular agitation in favor of it The ordinance requires that within a year after its passage and publication all railroads shall submit plans to the Commissioner of Public Works, and within six months after the plans and specifications have been approved they shall commence to electrify their roads If this ordinance is passed it will result in abating the smoke nuisance in Chicago to a large degree

The long lead in hydro-electric work maintained by the Pacific coast, which, with exceptional natural advantages, was early in the field is illustrated by the new power plant of the Great Western Power Company at Big Bend on the Feather River, Cal. the electrical equipment of which is described in the Electrical World The penstocks are the largest ever built for so great a head, the turbines themselves are of record size, 18,000 horse-power per unit, and are operated by what is certainly a record head of water for any turbines, 525 feet The transformers also are of record size, being three-phase units of 10 000 kilowatts capacity, with 100,000 volts on the high tension side Another big plant described in the same issue is that of the Grand Rapids-Muskegon Power Company which is remarkable for its high voltage generation, 110,000 volts being the highest yet attempted as well as for the simplicity of its arrangement.

SCIENCE.

Dr. F A. Cook has decided to submit to American scientific and geographic organizations duplicates of the proofs which are at the University of Copenhagen A simultaneous announcement is to be made in Denmark and this country as to whether he had furnished adequate proof that he had reached the North Pole

Ten grammes or about one-third of an ounce of radium chloride equivalent to one gramme of pure radium, is the total output for eighteen months of the Joachimsthal mines After the hospitals and scientific institutions have been supplied the remainder will be offered for sale at $75 000 a gramme or 15½ grains

Analysis of the natural gas coming from the Caucasus wells which is used for heating purposes, was made by M Meuschen as to the gas from the Bibi Eybat territory He finds the following composition in per cent Methane 54 80 hydrogen 13 58 saturated carbides 1 20 nitrogen, 20 42 oxygen 7 carbonic acid 3 Another sample gave only 0 80 hydrogen 60 0 methane and 25 nitrogen with the rest about the same

In a recent issue of the Astrophysical Journal Mr Walter S Adams of the Mount Wilson Observatory station summarizes the results of a study of the Mount Wilson photographs of sun spot spectra A discussion of the various elements whose lines are strengthened or weakened in the spot spectrum indicates that the changes observed may be best accounted for on the basis of a reduced temperature in spots A detailed study of the spectrum of iron furnishes especially strong evidence in this direction and the weakening of the enhanced lines in the spot spectrum is also most simply explained on the same basis The presence of the spectra of titanium oxide magnesium hydride and calcium hydride is sufficient to account for the greater part of the unknown fluting and band lines appearing in the spot spectrum The discovery of the existence of a magnetic field in sun spots by Mr Hale provides a ready and sufficient explanation for the widening of large numbers of lines in the spot spectrum for which there is no marked change of intensity

An apparatus for making enlarged tracings of sound-waves from a cylindrical graphophone record the magnification ranging from 150 to 2 500 times was described by F Proctor Hall before the British Association In the sound waves two elements are distinguished impulse and resonance which are illustrated by waves from the cornet, violin bugle etc Vocal waves are found in groups regularly repeated Each group contains a single impulse from the vocal cords together with one or more sets of resonance waves produced by vibrations of the air in the vocal tubes Pitch is determined by the number of impulses per second—i e by the number of wave groups—and is not affected by the character of the waves within the groups. The vowel quality of vocal sounds is not perceptibly affected by the number or form of the resonance waves but is dependent upon their periodicity The rate of the resonance waves may be calculated from the length of the air tubes upward from the vocal cords The calculation shows for example that the sounds *m* *n* *ng* all contain a resonance wave whose period is about 530 The mean rates found from measurements of the enlarged waves are for *m* 500 for *n* 535 for *ng* 580 The observed rate for the sound of *a* in the word great is 420 and for the sound of *a* in 'mat 770 waves per second

Mr Durand, United States Census Director has made an appeal to farmers all over the country to assist him in securing accurate agricultural returns at the coming census He trusts that farmers will keep or provide some sort of written record of their operations during the year 1909 Each person in charge of a farm will be asked to state the acreage and value of his farm—that is the acreage and value of the land kept and cultivated by him the area of land in his farm covered with woodland and finally that which is utilized for specified farm purposes the acreage quantity produced and value of each crop including grains, hay vegetables fruits cotton tobacco etc, raised on the farm in 1909, the number and value of all domestic animals poultry and swarms of bees on the farm on April 15th 1910 He will also be asked to state the number and kind of animals sold during 1909 and the receipts from such sales the number purchased and the amount paid therefor and also the number slaughtered for food and the value of such animals The census act provides that the information shall be used only for statistical purposes for which it is supplied No publication shall be made by the Census Office whereby the data furnished by any particular establishment can be identified nor shall the Director of the Census permit any one other than the sworn employees of the Census Office to examine the individual reports Furthermore the information reported on the agricultural schedule will not be used as a basis of taxation or be communicated to any assessor

The Employment of Liquid Air and Carbon Dioxide in the Treatment of Diseases of the Skin.

The lack of specific remedies for many diseases of the skin has caused a diligent search for new remedies more efficient or less disagreeable than those in common use An epoch in dermatology was marked by the introduction of Roentgen rays which exert a curative action in many cases of eczema attended with profuse exudation and intense itching in psoriasis and in many fungous diseases of the skin and hair Cathode rays have proven beneficial in numerous cases of lupus and quite recently malignant tumors of the skin have been cured by these rays

But in many cases treatment with rays failed to effect a definite cure and the experiments with other physical and chemical agencies were resumed An American physician tried liquid air and carbon dioxide and obtained more or less success in cases of tuberculous abscesses moles pimples and superficial cancer of the skin The method of treatment is as follows Cotton wool wound tightly on the end of a rod is dipped into the double-walled glass flask of liquid air and then pressed lightly on the affected part of the skin The skin freezes and becomes inflamed and in from 10 to (days the morbid growth sloughs off

But liquid air is expensive and it also acts too energetically An equally efficient but cheaper and more manageable agent is carbon dioxide which was first employed for this purpose by Pusey From the steel cylinder which contains liquefied carbon dioxide the vapor is allowed to escape into a glass tube Here it condenses into snow which is compressed by a piston into a hard mass This can be trimmed to the size and shape of the morbid growth to which it is to be applied and thus the freezing of the surrounding healthy skin can be avoided

The temperature of carbon dioxide snow is 130 deg F while that of liquid air is about – 290 deg F The snow is cold enough however to freeze the skin into a hard white mass in a few minutes Too long an application may cause necrosis or death of the underlying tissues The skin subsequently becomes slightly inflamed and a blister similar to that caused by a burn is produced In general freezing and burning produce similar effects on the skin In two or three weeks the part that has been frozen falls off as a scab revealing skin of quite normal appearance or marked by a slight scar The application of this remedy is not attended with great pain In the treatment of facial blemishes especial care must be taken not to freeze the skin too deeply The field of application of carbon dioxide snow is extensive Hitherto good results have been obtained chiefly in cases of lupus but small tumors callosities moles pimples etc have also been treated with success—Dr Bergrath in Die Umschau

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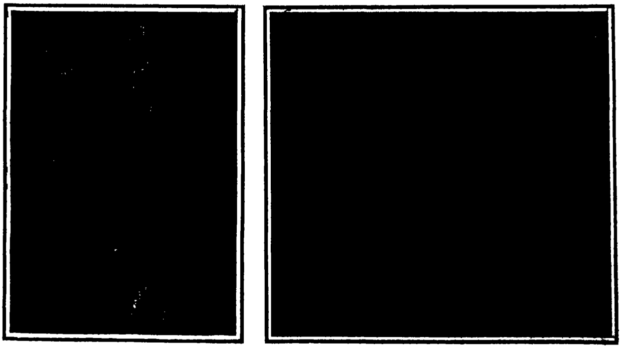
CYCLING TRICK IN A BERLIN VARIETY THEATER

The accompanying illustrations picture a trick performance which recently attracted much attention in Germany In the first photograph a cyclist is shown traveling outside a globular cage on a narrow wooden path He uses an ordinary bicycle wheel of 28 inches diameter and that of the globe is ten times as great viz 280 inches The circumference is consequently 280 π = 879 6 or roughly 880 inches. The globe is rotated by the friction of the cycle wheel on the top Every minute it makes 30 revolutions or 1 800 in one hour Any point of the equator travels a path equal to 880 times 1 800 in one hour or 1 584 000 inches As one mile is 63 360 inches it means that

$$\frac{1\,584\,000}{63\,360}$$

= 25 miles are covered in one hour The cyclist must be very careful to keep in the center of the path By far the greatest difficulty lies in the fact that his weight constantly draws him down the slope in front as well as backward In other words he must not only keep his balance right and left but also forward and backward The latter feat he accomplishes by accelerating or retarding his bicycle

The other photograph shows two men inside the cage They rotate the globe through the frictional contact of their wheels with the globe



THESE TWO ILLUSTRATIONS REPRESENT A REMARKABLE BICYCLE TRICK WHICH ATTRACTED CONSIDERABLE ATTENTION IN GERMANY A GLOBULAR CAGE 280 INCHES IN DIAMETER IS FRICTIONALLY ROTATED AT HIGH SPEED BY AN ORDINARY BICYCLE.

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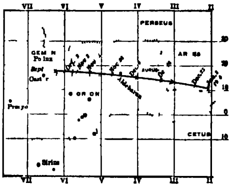
THE FIRST PHOTOGRAPH OF HALLEY'S COMET

In this photograph of Halley's comet the arrows indicate the position of the comet At present the comet can be seen only through a powerful telescope



The path of Halley's comet from the date of its discovery to January 1910.

THE FIRST PHOTOGRAPH OF HALLEY'S COMET

The accompanying photographs of Halley's comet were printed from negatives made with the Yerkes two-foot reflector by Mr Oliver J Lee on the nights of September 24th and September 26th astronomical or on the early mornings of September 25th and 27th civil The photographs are here published by permission of the director of the Yerkes Observatory editor of the Astrophysical Journal in the October number of which magazine these pictures are appearing together with photographs taken on other dates On September 24th the exposure was from 13h 12m to 15h 42m central standard time on September 26th from 14h 47m to 17h 47m central standard time The arrows point to the comet which is slightly elongated on the 24th due to the motion of the comet during a two and one-half hours exposure The picture is much enlarged and the stars shown are actually very faint none of them visible to the naked eye The brightest star in the field at the left of the comet on each day, is of magnitude 8 7 or about ten times fainter than the faintest star that can be seen with the naked eye without a telescope on a clear night. The faintest stars shown on the original plate are about twenty-five thousand times as faint as a sixth-magnitude star, the limit of naked-eye visibility The comet's motion in the sky at this time is comparatively slight and will be very much greater later The comet was retrograding or going westward at this time as seen from the earth (to whose motion this retrogression was wholly due) having ceased its eastward motion a few days before.

The comet has been micrometrically observed on several nights with the forty inch Yerkes telescope by Profs. Burnham and Barnard On the 26th it was estimated by Prof Barnard to be of magnitude 14 or 14 5 with a diameter measured as 10 sec., but without definite boundary The presence of strong moonlight is likely to prevent the observation of the comet either visually or photographically for several nights after September 27th

* * *

A High School of Aerial Navigation in France.

It is due to the energetic efforts of Commander Rocher who has succeeded in enlisting the assistance of a committee the members of which are all well known in the scientific world that a special high school of aerial navigation has been organised in France on the following basis

1 All former students of the polytechnical schools, the schools of bridges and highways and mining engineering and of naval construction will be admitted as a matter of course Graduates of science (in general physics and mechanics) will be admitted upon passing examination in the drawing of machines Other places will be awarded upon open competition

2 The course of instruction comprises one scholastic year

3 The principal courses of instruction will be in all branches of aerial navigation aerostatics and aviation and about motors especially gas motors The annual lectures about the various topics are arranged in such a way that the students will be kept posted about all evolutions in aerial navigation and of the sciences relating to it

4 Independent of these courses of instruction the students will have to execute practical work relative to aerial navigation and to motors

5 To students who have completed all the courses as well as the technical work and have successfully passed the examinations the diploma of engineer of aerial navigation shall be awarded

6 Besides the regular students any person may attend one or several courses without however participating in the technical work and without being entitled to examinations or to the award of the diploma

7 The tuition fee for regular students is $200 The fees for other persons vary according to the number and the importance of the courses which they desire to attend

It seems only logical that France having been the first country to promote aerial navigation shall also be the first one to organize a higher course of instruction in same on a thorough and rational basis

* * *

Another new hydro-electric plant is to be commenced shortly in Canada on the St Lawrence River near St Timothee Quebec The main features of the initial development are a canal intake and headgates about 3 200 feet below the present intake enlargement of the Beauharnois Canal from the intake to the station site a distance of 33 000 feet and turbines of 21 600 horse-power capacity The generators will consist of three 4 000-kilowatt turbine units two 250-kilowatt exciters, and there will be three 4 000-kilowatt transformers A transmission line 27 miles long to Montreal will be constructed, with transformer sub-stations and distribution system there The present developments are expected to cost $4,000,000, the contract being let on the cost plus commission basis.

SAVING THE AMERICAN LOBSTER.

BY P HARVEY MIDDLETON

The little town of Wickford Rhode Island is the home of a most important and successful fish culture station. Here is situated a hatchery that has demonstrated the possibility of saving the lobster from the fate of absolute extermination The conservation of this favorite crustacean has been a perplexing problem for many years both in America and Europe Even Japan has recently taken a keen interest in the subject Until the last few years the most earnest efforts to propagate lobsters artificially have failed to offset the ravages of their enemies of the deep to say nothing of the onslaughts of man The steady decline of the lobster fishery emphasized the urgent need of more scientific methods

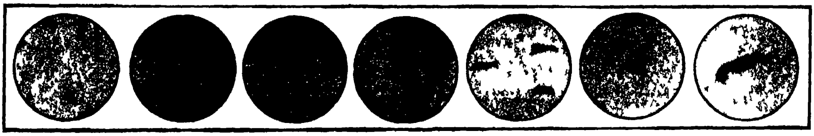
Cylinders in which individual lobsters are confined for observation

Drying a 12-foot lobster bag after it has been washed.

From the moment it breaks the egg membrane and emerges into the outer world the tiny lobsterling is at the mercy of every swimming thing—a choice delicacy that is devoured with equal impartiality by the plebian herring and the aristocratic bluefish For a time the minute translucent creature born with a voracious appetite ekes out a precarious existence on the microscopic organisms of the sea together with hundreds of its brothers and sisters born at the same time. As in our own world so it is in the lobster kingdom The more active get the most food and grow bigger and stronger than the less nimble And as soon as he realizes his superiority the larger lobster immediately starts devouring his smaller brethren Settling to the bottom of the water he will calmly seize the one nearest quite indifferent whether it is a near relative or merely a chance acquaintance The cannibalism of the baby lobster has always been the greatest impediment to the success of lobster culture

But confirmed cannibal though he is the lobster is nevertheless a timid nervous creature thriving only in the twilight and being most active after dark His natural home is in the cracks and crevices of the most rocky shores and he seldom ventures forth except in search of food which is dragged back to his retreat The stronger the light the more cautious he becomes and the daintiest morsel of chopped clam—his favorite dish—will not tempt him into the light of day If exposed to the sun he will wander nervously about until he finds a dark spot

A few years ago a little houseboat laboratory was started in the harbor of Wickford under the joint auspices of Brown University and the State of Rhode Island with the object of studying every phase of lobster life After numerous experiments Prof A D Mead who was in charge came to the conclusion that the secret of success in rearing the young lobsters was to keep the water in continuous motion thus preventing the little creatures from catching and swallowing one another This also kept the food in suspen



1 Lobsters in first stage of their development at which time they are one day old

2 Lobsters in second stage, having molted their skin once Four days old.

3. Lobsters in third stage of their development about eight days old

4 Lobsters in fourth stage having molted three times About two weeks old

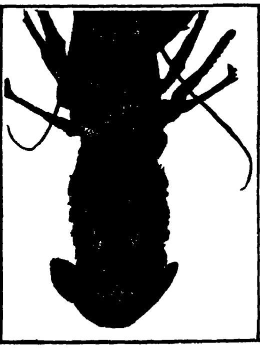
5 Lobsters in the fifth and sixth stages of their development

6 Lobster in the seventh stage of its development

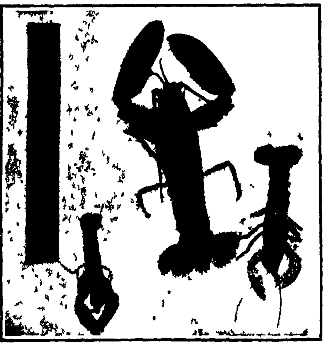
7 Lobster seven weeks old at which time he becomes recognizable

The seven ages of a lobster. The photographs are all life size

This lobster traveled ten miles in eight days. The copper tag attached asks the finder to return it.



An adult female lobster in "berry," or bearing egg clusters under the tail.



Three young lobsters of the same age, showing the great difference in growth

SAVING THE AMERICAN LOBSTER

sion so that the fry might obtain it. Simple as this solution of the problem was, no one had ever thought of it before.

To prove the correctness of this theory, it was decided to experiment with the lobsters, which were at that time in small bags. The water in the bags was stirred with an oar continuously for six days and nights. The result was a brilliant success. The evident efficiency of this crude method of stirring in maintaining the life of the young fry naturally suggested a mechanical contrivance for protecting the fry during the extremely critical period of their early life.

Consequently a series of bags 12 feet square and 5 feet deep was sunk into the water and tied securely in place. In each bag near the bottom was placed a two-bladed rotating fan resembling that commonly in use over restaurant tables. These fans or propellers were connected with vertical shafts which in turn were geared to a gasoline engine. When the machinery was set in motion the rotation of the fans created a continuous current of water directed upward from the bottom of the bags, the force of the current being readily controlled by altering the angle of the blades. This also prevented the accumulation of parasites on the young lobster's body.

Scientists will tell you that from 30 000 new-born larvæ which represent the average total mass of the brood produced by one pair of lobsters during their lifetime only one pair of mature lobsters are alive after a lapse of seven to nine years. The lobster fishermen have been at their wits' end to supply the ever increasing demand of hotel and restaurant for this popular sea food. Now it bids fair to become so plentiful as to be within the reach of the humblest purse.

Before the installation of the stirring device at Wickford it was the custom to turn out the young fry soon after hatching. But the young lobster at birth is as helpless as a human baby with only feeble means of locomotion and no defensive weapons. There are many stages in the life of a lobster at each of which he sheds his skin or shell and grows another. It is not until the fourth stage that he assumes the familiar form of the lobster, and is able to defend himself to a certain extent.

A successful effort was made to hatch the lobster eggs with the same stirring apparatus. Female lobsters were obtained from Newport and the eggs were combed off in the ordinary manner and placed in the stirring bags. When the propellers were set in motion these eggs were gently swirled about and hatched into very beautiful young lobsters.

During the first three stages the lobsters swim near the surface in an aimless jerky way that reminds one of a wiggle-tail. The first stage lasts about three days, the second about four or five days and the third usually about five or six days. From nine to sixteen days are required for the larvæ to pass from the first to the fourth stage.

A most marvelous change of form and an even more astonishing change of habits occurs at the third molt. The emerging fourth-stage lobster has the general form of the adult. The abdomen is no longer bent down at right angles to the body but as in the adult extends straight behind. The downward stroke of abdomen which was the chief means of motion during larval life is now used as in the adult only for rapid retreat. All five pairs of walking legs have lost their upper branches and the first pair which are now the large characteristic "nippers" are extended straight in front of the head while the lobster is swimming. These structural changes are accompanied by more radical changes in habits and instincts. The lobster no longer helpless upon the bottom burrows under shells or stones and picks out a home from which it sallies forth in search of prey. In shedding its third skin it has cast off all its previous timidity, and with its strong crushing claw is ready to defend itself against all comers.

A new style of swimming which lasts only a week or two is now adopted. The tail being extended straight behind the body and the large claws extended in front of the head the lobster swims forward in a perfectly straight and definite course by the strokes of the swimmerets. No trace of its former aimless activity remains for the lobster now actively seeks food, avoids enemies and retreats from danger. The active but careless and helpless infancy has been succeeded by enterprising independent youth. The fourth-stage lobster has passed the most critical period of its entire life and is vastly better fitted for the struggle for existence than at any earlier stage.

In the first molts as in the succeeding ones the process is the same, the old skin being split across the back between the thorax and the abdomen and the body working out through this opening leaving the cast-off skin otherwise intact. The actual process of molting occupies only a few minutes but occasionally something goes wrong and the struggle is quite prolonged. Often the lobster dies in the process and the period of molting is at best a very precarious one.

Last year 294 896 lobsters of the fourth stage counted singly after being taken out of the hatching bags with a tea strainer, were liberated in various places along the shores of Narragansett Bay. These thousands of lobsters have more value for the improvement of the local lobster stations than as many millions of larvæ of the first stage, with the setting free of which the experiment stations had previously to be satisfied. But even after the lobsters have been reared to the fourth stage their future chances of life depend in some degree, on the time and place and manner of their liberation. Thus far it has seemed best to liberate them in the morning so that they may find hiding places and settle themselves before night falls and to scatter them over a considerable extent of territory, so that they may not gather in a conspicuous swarm.

For years the United States Fish Commission has hatched at Woods Hole, Gloucester, and at other stations many millions of eggs annually, and have set free the young as soon as possible after they were hatched. But in this case the fry are distributed in deep water, and are thus in less danger from their natural enemies which like the mummychog and the shrimp abound in shallow water. The apparatus used in hatching at Woods Hole is the McDonald jar into which the eggs are placed immediately after they are combed from the females. In this they are kept swirling sometimes for weeks by a constant stream of salt water.

The lobster ranges from Labrador to Delaware, and inhabits the waters from the very shore to a depth of more than one hundred fathoms. It is thus confined to a strip of the Atlantic Ocean about 1 300 miles long and at some points as the coast of Maine from 30 to upward of 50 miles wide. The number of eggs or seed carried by the female on the under surface of her tail varies from 10 000 to 20 000.

At Wickford the young lobsters are raised from the egg to maturity in order to determine not only their habits and requirements at various stages and in various seasons but to ascertain as nearly as possible the normal rate of growth. When the fourth stage is reached a number of lobsters are put into cars provided with sand, gravel and seaweed to stimulate as closely as possible the natural environment. The sides of the cars are made of galvanized iron screening which allows a free circulation of water.

During the summer the cars are suspended from the house-boat or from floats so that the water in them is about eighteen inches deep. In the fall they are provided with tight-fitting covers and sunk in the channel in from eight to ten feet of water, and left undisturbed until spring. The lobsters are frequently fed during the summer on chopped clams, fish and several other varieties of food but in the winter no food is given them although they may obtain some food from the water or from the animal organisms which grow in the car. The cars seem to furnish a natural environment for not only are the lobsters in a healthy condition but seaweed, oysters, clams, mussels, shrimp, tunicates, barnacles, various specimens of marine worms and other animals grow inside of the cars as rapidly and normally as in other places.

An interesting part of the work at Wickford is the liberating of a number of lobsters with copper tags attached to them. Last summer 210 were set free with tags bearing a number and the words "Return to the Rhode Island Fish Commission." Thirty-six of the tags were returned by lobstermen with the date and place of capture and valuable information on the movements of the lobsters was thus obtained. Although the greater number returned had not wandered far some had made their way southward for several miles. The lobster bearing the tag "75" shown in the photograph which was caught one mile southwest of Beaver Tail holds the record up to date for fast traveling having covered a distance of ten statute miles in less than eight days.

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Official Meteorological Summary, New York, N. Y., September, 1909

Atmospheric pressure: Highest 30.48, lowest 29.81, mean, 30.10. Temperature: Highest, 79, date, 3rd; lowest 48, date 29th, mean of warmest day, 74, date, 23rd, coldest day 58, date 28th and 29th; mean of maximum for the month, 72.2; mean of minimum, 59; absolute mean 65.6; normal 66.4, deficiency compared with mean of 39 years 0.8. Warmest mean temperature of September 72, in 1881, coldest mean, 61 in 1871. Absolute maximum and minimum of September for 39 years, 100 and 40. Average daily excess since January 1st 1.1. Precipitation: 2.66, greatest in 24 hours, 0.83, date 27th and 28th, average for September for 39 years, 3.61. Accumulated deficiency since January 1st 0.95. Greatest precipitation 14.51 in 1882; least 0.15 in 1884. Wind: Prevailing direction northwest; total movement, 7,335 miles, average hourly velocity, 10.2; maximum velocity 45 miles per hour. Weather: Clear days, 10; partly cloudy 9; cloudy 11; on which 0.01 inch or more of precipitation occurred 7. Frost, light, 29th.

Correspondence.

THE FLOORS OF PANAMA LOCKS.

To the Editor of the SCIENTIFIC AMERICAN:

I notice in your last week's issue an interesting description of a plan for anchoring down floors of locks in the Panama Canal, to prevent lifting and injury by upward pressure of seepage water.

As an unbiased bystander, "watching the game," I venture to suggest that any possible pressure of the kind feared could be easily relieved by providing small openings at intervals in the floors of locks, with steel tubes extending vertically from upper to lower surfaces, with valves which could be opened to allow seepage water to flow into locks freely during inspection.

Such safety valves could be inserted with very much less expense than anchorages proposed. Would some of your readers interested in hydrostatics kindly point out any practical objections there might be to such a procedure? R. ARMSTRONG.

Rock Park, Ramona, Cal.

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THE NUMBER OF OUR ANCESTORS.

To the Editor of the SCIENTIFIC AMERICAN:

Will Mr. Solon De Leon kindly give us his authority for his "consanguine groups"? The more the habits and customs of primitive peoples are studied, the more it becomes apparent, I believe, that they have, and had strict rules preventive of all close interbreeding. I am not in a position to name authorities, but have just been reading John Rhys's "Studies in the Arthurian Legend," in which, referring to such matters, he says: "Celtic mythology fails to carry us back to a state of society where it could have been possible." (See page 227.) Mr. Eckles's isolated communities were bad enough, but now we have Mr. De Leon's family groups, all the daughters of which were wives of all the sons, yet science is emphatic in teaching that all inbreeding, whether of plants, animals, or man, is fatal, and leads to the degeneration and extinction of the race. And Nature confirms the same. These gentlemen greatly exaggerate the conditions, I think, or surely we should all have vanished off the scene centuries ago! If "consanguine groups" ever existed it must have been in the very infancy of the race and certainly could not be placed within the last 25 000 or 30,000 years.

Should it be true that it is next to impossible to find any two Englishmen who have not an innumerable number of ancestors in common, then it can only be a question of time when the same truth would apply to all human beings. We are told that everything is possible in this wonderful world except logical contradictions, are not these theories a fair example of such? Isolated and consanguine groups would tend to keep the general population separate and so cut both ways. In any case, the problem as given in my last letter in your issue of September 11th remains unaffected. Such a case of intermarrying as F. W. A. specifies must surely be very rare indeed!

Doubtless the intermarrying of relatives explains much of the puzzle but it will not bear all the weight some of your correspondents are willing to risk upon it.

Los Angeles, Cal. A. K. VENNING.

The Current Supplement.

Just now the popular conception of Fulton is that of a man who invented steam navigation. A critical consideration of what he really did is presented in the current SUPPLEMENT No. 1763. The very high power which is now demanded of naval ordnance, especially the main armament of battleships, has led generally to a consideration of the utmost importance—the life of the guns. This question will be found admirably discussed in a thorough article. Well-equipped experimental laboratories are indispensably necessary for the progress of aviation. One of these is the Aerodynamic Institute of Kutchino, which is well illustrated and well described. Steam turbines may be governed in several ways, which are considered in a carefully prepared article. The admirable résumé of importance in the internal-combustion engine begun in a recent number by Mr. H. E. Wimperis is continued. The old dusty road that winds from the landing of the village of Capri to the mountain top behind the village will no longer be used by the tourist. A cable railway now takes its place. This railway is described and illustrated. E. Sherwald writes on some decorative designs derived from the polarization figures of quickly-cooled glass. Prof. L. Jaloustre contributes a simply worded article on catalysis. G. Espitallier discusses building methods in the earthquake regions. The makers of arc lamps have several times devised more or less ingenious lamps, in which the clockwork or motor by which the carbons are moved as they are consumed is suppressed. Most recent attempts of this kind are to be found in the Beck arc lamp, which is described in the SUPPLEMENT. Oliver Light contributes a suggestive article on the making of automobile repairs.

STRANGE SCIENTIFIC ANOMALIES AT THE NORTH POLE.

BY JAMES ARTHUR.

In the illustration, Fig. 1, *N S* is the earth's axis, on which it rotates, *with reference to the sun*, in 24 hours of mean or clock time. This axis is purely imaginary, yet the fixity of its position is one of the fundamental facts in astronomy The same remark applies to the earth's rotation on this imaginary axis. When we remember that the earth is nearly as heavy as a ball of iron, and that the surface velocity at the equator is about 17 miles per minute, we can form some conception of this uniformity Mathematicians lead us to conclude that this rotation and its axis, or center line of motion, are not eternal and that they will change, but for the historic period we may consider them uniform and permanent. Finally, they are the nearest to absolute uniformity and fixity that we know of. A minute slowing of the rotation would not disturb anything, beyond keeping the astronomers busy correcting their tables, including those of our erratic neighbor, the *moon*

Did you ever think what would happen if the axis of rotation changed a little? The polar diameter of the earth is about 26 miles shorter than the equatorial diameter, therefore each pole is "flattened" 13 miles, so the section of the earth, if split through the plane of a meridian, would be elliptical Remember, this is the *sea level* form of the earth Now let us suppose the axis to be changed so as to *reduce* the latitude of New York by bringing the new equator nearer to the city The city would then be covered by the waters of the Atlantic and the land near the new poles would be left high and dry That is, the ocean level would *rise* on New York and *fall* at the new polar region On this assumption—that the axis could be changed on the meridian plane of New York—two very interesting and impressive questions arise

1st. What diminution of latitude would raise the waters of New York Bay one thousand feet, and thus cover the city with Atlantic water?

2nd What increase of latitude would lower the waters of the bay forty feet and leave all New York docks simply mud holes?

Clearly it is *perilous* to disturb the earth's axis.

Refer to Fig 1, where the sun *A* is shown *on the line* at the spring equinox An observer on the equator at *E* would see the sun on the celestial equator just where he is, that is half his face on each side of the celestial equator An observer at the North Pole *N* would see the sun the breadth of his face higher at *B* than his real position *A* An observer at *S* would see him at *C* This is caused by the refraction of the sun's rays in passing through the atmosphere, and it is a remarkable fact that the average amount of this refraction at the horizon is just about the breadth of the sun's face, so that the three suns seen by the observers *N E S* would touch one another as shown

Now let us assume level land within the Arctic circle and that we have built an astronomical observatory on the pole To make things balance, let the observatory be built in the form of an Irish 'round tower" How would we know the location of the pole so that we could build an observatory on it? "Oh" you say, 'that would be easy Just build it plumb under the pole star" Not at all. If we did that, we would be about 85 miles *from the pole The reason of this is that* the so-called "pole star" is only the nearest bright star *to* the "*polar point*." This popular pole star makes a daily circle around the "polar point" about 4½ times as broad as the sun's face and we must make the sharp cone of our round tower point to the center of this circle Then we would have a "pole" worth speaking about.

Sitting in the top of this tower what would you see? The sun sweeping around the horizon once in 24 hours, but a little higher each day in a grand spiral course in the celestial sphere, as compared with the horizon In a little over three months he would be above the horizon 23½ degrees, and this would be the middle of the "great day"—and the longest day at New York.

We are now in a position to make some wonderful and unusual experiments and observations. One of the delicate experiments would be to determine the length of a pendulum beating seconds at the pole This would enable the mathematicians to correct their figures as to the form and density of the earth, two matters of great astronomical importance In this observatory we would determine any meridian such as Greenwich and get its local time as easily as in any observatory south. Now stand with your back to the pole (round tower) facing south on the "first meridian" and walk down this meridian a little over three and one-half miles till you come to a circle of latitude 24 miles in circumference *G* Fig. 2. Now face west with your right hand to the pole, and stand there till your shadow points straight to the pole. This would be noon at Greenwich Start walking due west on the circle *G M* at the rate of one mile per hour. As you walk what changes would you see? None whatever for your shadow would steadily point to the North Pole (round tower) and the sun would appear to stand still in the sky. You could see only the motion of your feet over the ground. What were you doing during this 24-hour walk? With respect to the sun you were not moving, but simply *treading the ground* with your feet. On this 24-mile circle of latitude you were walking one mile an hour *west* but as the earth rotates one mile an hour *east* on this circle you were just neutralizing its motion and making no headway with reference to the sun Let us now go out to a circle of latitude of 48 miles circumference *O P*, and on each of the 24 meridians here draw a circle two miles diameter These circles would just touch one another, as shown on Fig. 2 Set up a flagstaff in the center of each of these circles. Divide each circle into 24 hours, marking 12 on the meridian, on the side of each circle toward the pole Only the Greenwich and New York dials are divided in this illustration You have now 24 sundials, each *one giving the local time* of its meridian, and it would be *noon* on each meridian when the shadow of the staff pointed straight to the round tower on the pole Now consider the shadow of our round tower observatory at Greenwich noon when the staff shadow points to the pole on the meridian *of zero, then the shadow of the sharp tip of the* tower would fall on meridian 180 degrees and indicate midnight, or 24 o'clock on that meridian and so for all other meridians We would thus have *noon* and *midnight* on each of the 24 meridians every day These 24 dials would read consecutively one hour apart This 180th meridian is the theoretical 'date line', or beginning and ending of a date Since a day is always beginning and ending at the 180th meridian you could walk from to-day into to-morrow or from to-day into yesterday as often as you pleased But if you sat in the center of the observatory on the pole you would have all times in the 24 hours and no particular time No local time—no north east or west You could move only south at the first move Your parallel of latitude would be a point Your meridian would be all the meridians—and none of them! Any wind passing over the pole would blow *from* the south and also *toward* the south at the same time. If you tried to go farther north you would be going south

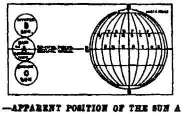

Fig 1.—APPARENT POSITION OF THE SUN AT THE EQUATOR AND AT THE POLES.

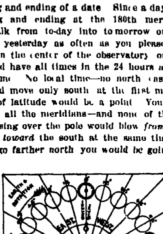

Fig 2.—DIAGRAM ILLUSTRATING ANOMALIES OF TIME AT THE POLE.

These suppositions have been made for about the middle of the great polar day, but this day is worthy of some attention. Probably you suppose that it means simply six months day and six months night You are wrong As shown above, in connection with refraction the sun at the spring equinox is clear above the horizon and the same at the autumnal equinox, as shown in Fig 1 If you will add to this refraction the slight dip of the horizon, as seen from the tower observatory and also a few days of twilight morning and evening of the 'great day, you will have several days more than half a year But this is *not* all for the sun is almost four days more than half a year *above* the celestial equator that is *four days* longer than half a year between the spring and autumnal equinoxes. All *these* lengthen the "great day' so that it would be a good practical working day of about seven months. Remembering our assumption of *level land* and clear weather in the polar region the apparent motion of the sun would be wonderful He would appear simply to rise straight up and then down but his daily course *around* could be observed only by shadows, or from the observatory so that in the open for a short period, he would appear absolutely fixed in the celestial sphere.

How would the moon behave? During the great day she would be only above the horizon along with the sun, and show *only third quarter—dark—first quarter*, so would be invisible in the glare of the sun Let us now assume about the middle of the great night The moon would rise in the first quarter, and as she slowly climbed up her face would come nearer to being *full* till in a little less than seven and a half days she would stand up full at her culmination of 23½ degrees above the horizon She would sink at the same rate, gradually coming to the third quarter as she set. To use popular language the moon would rise half face bright—creep up to full face—and then sink to half face again as she set remaining up steadily for nearly fifteen days During the time she was visible she would sweep the heavens—compared with the sun, not once in 24 hours—but once in 24 hours and 50 minutes This is caused by her monthly motion which is *against* her apparent motion in the sky We thus see that the moon rises and sets each lunar month just as the sun rises and sets each equinoctial year City people do not notice this very often but the old farmer needs the moon and puts it in round numbers the *moon* rises three-quarters of an hour later every night" All this is the average an observer would see but by using instruments he would find many variations in the moon's motions

Let us suppose that the moon has set thus leaving us in the black polar night till the next moon about a fortnight hence What motions would you look for in the stars? None whatever, the whole celestial dome would appear to stand still day after day Stars near the horizon would stay there and those overhead would show no motion But if you went into the observatory and turned a telescope on any star you would find it moving horizontally Stars at the horizon would move the fastest and as you pointed your telescope higher and higher they would move slower and slower till you reached the pole star' which as noticed above, would move in a little circle of less than 2½ degrees the center being the polar point 'dead plumb' under which stands our observatory This slowness and *fastness of the various stars* is caused by the fact that they all make a horizontal circle in a sidereal day of approximately 23 hours 56 minutes If you wish more information about this sidereal day—the 24-hour sun day and the moon day of 24 hours and 50 minutes—you must go to your cyclopedia or still better call at the Naval Observatory in Washington, D C as space cannot be taken here

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An Opinion of the Scientific American Supplement

In The Publisher and Retailer for September 1909 appears a communication which displays not a little knowledge of the SCIENTIFIC AMERICAN SUPPLEMENT not only from an editorial standpoint but from the publisher's standpoint The writer states

A remarkable periodical is the SCIENTIFIC AMERICAN SUPPLEMENT a sterling weekly established in 1876 The original idea was that it should run out that year and concern itself with the Centennial Exposition which made Philadelphia famous But the SUPPLEMENT found itself firmly anchored at the time the owners had planned to kill it *and it has been continued* weekly ever since The remarkable things about it are several—perhaps the most so is that it prints no advertisements though it is a meaty sixteen pager of the size of Collier's For revenue its publishers look only to the circulation end of the game It is so far as your uncle knows the only *bona fide* advertisementless periodical in existence A file of the SUPPLEMENT is in a scientific way the greatest of encyclopedias nothing finding place in its pages unless of practically permanent interest and value Even remarkabler probably is the fact that all numbers of the SCIENTIFIC AMERICAN SUPPLEMENT are kept constantly in print—ten cents will purchase a copy ten twenty or thirty or more years old as readily as a current issue The sale of back numbers warrants the publishers in keeping in print the seventeen hundred issued since January 1876 To make sale for the back numbers a catalogue is issued from time to time and in this is revealed the contents of all the issues which have gone before Remarkablest perhaps is the fact that while the SCIENTIFIC AMERICAN is on sale to the trade and for which there is no back number sale the SUPPLEMENT is not whereas one would think it is the one which should be made returnable as returned copies would not be dead stock as must be the case with the other publication'

The Publisher and Retailer circulates largely among newstand dealers and the SUPPLEMENT is not designed primarily for newsstand circulation Hence this opinion of its virtues addressed to a class of dealers who are not likely to be interested in its editorial merits is all the more acceptable

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From a report of comparative tests made by an American trunk line on the new ferro titanium steel rails and those of the Bessemer type it is noted that the wear on the former showed 1 45 pounds per yard as against 4 18 pounds per yard on the latter which is nearly 300 per cent in favor of the new alloy steel

PLAYING A 'CELLO BY COMPRESSED AIR.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN

At a recent concert in London one of the programme features was a violoncello solo, rendered in conjunction with the "auxetophone" the invention of the Hon C A Parsons of turbine fame. Through the courtesy of the inventor we are enabled to describe and illustrate this novel attachment to musical instruments whereby the tone of the latter, to which it is attached, is appreciably increased by means of a current of compressed air

The auxetophone may be best described as a comb or multiple-reed valve of aluminium which comb is hinged in such a manner that each tooth of the comb can vibrate at a variable distance from a corresponding slot in a little box to which compressed air is supplied at about five pounds pressure The farther away the teeth are from the slots the greater is the flow of air and *vice versa*. The flow of air is controlled by a valve and when caused to vibrate the air transmits corresponding sound waves into the trumpet.

When the auxetophone is applied to the 'cello or any other stringed instrument, the valve is connected by a rod of aluminium with the bridge of the instrument Thus the valve is caused to vibrate in accord with the characteristic tone of the instrument The sound issuing from the trumpet though in many respects identical with that of the instrument itself is at the same time richer in character and greater in volume

In the accompanying illustrations the disposition and details of the apparatus are clearly shown A special bar is carried across the sounding box of the instrument to support the multiple reed valve and its box The current of compressed air enters the box at its lower end The aluminium connecting rod between the valve and the bridge of the instrument is clearly shown

The air is compressed in a small portable cylinder The current first passes through a pressure gage at the player's foot the dial of which can be instantly and easily read and followed From the pressure gage it passes to a small air filter which removes all suspended impurities. Then it passes to the lower end of the valve box mounted on the instrument. Between the pressure gage and the filter is a small pedal, by means of which the player can modulate the flow of the compressed air by means of his foot

The horn is mounted on a stand beside the instrument and a flexible pipe coupling connects the valve box of the instrument with the horn The valve mechanism support is so made that it can be attached to or detached from the instrument in a few moments

At the concert previously mentioned, the possibilities of the invention were very strikingly evidenced The tone of the instrument was appreciably fuller richer and stronger when the auxetophone was attached the harmonics were clearer and the high pitched notes were more clearly defined than is possible without the attachment. In the fortissimo passages the tones had a solid well-rounded ring of great volume while in pianissimo the expression of the artist was well produced with a softness accompanied by distinct clearness of the tones.

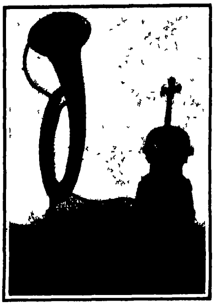

Fig 1 —'Cello with the auxetophone attached which delivers the sound waves to the trumpet On the floor is a pedal for modulating the air pressure, a pressure gage, and air filter

Fig. 2 —View of the instrument, showing mounting of the valve mechanism and aluminium connection between the bridge of the instrument and the valve

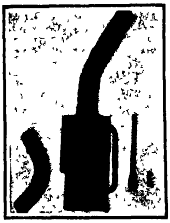

Fig. 3.—View of the instrument looking on the delivery side of valve

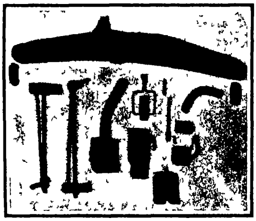

Fig 4.—The several component parts of the auxetophone

PLAYING A 'CELLO BY COMPRESSED AIR.

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Timber is scarce at Tucson Ariz and fence posts are expensive Recently states the Industrial World the manager of the Tucson Rapid Transit Company found it necessary to string some wire fencing and in lieu of fence posts he cut up a lot of old boiler tubes into suitable lengths and made holes in them to attach the wire fencing He made some convenient gates by sliding 4 inch tubes inside of 4½ inch tubes the collapsible tubes serving the purpose of cross bars. Recently, in sinking a well for power-station circulating water, he utilized the shells of two water-tube boilers, sinking them one above the other to a depth of 36 feet.

The Budde Hydrogen Peroxide Process for Sterilizing Milk.

The problems confronting a public pure milk supply are only too well known. The greatest difficulties arise from the fact that trade milk is drawn from so many quarters and such a varied assortment of sources and then promiscuously mixed, that even if the supply from one set of cows should be pure, it is immediately contaminated by its admixture with the product from other doubtful cattle Sterile milk in the generally accepted sense of the word is practically impossible to obtain Numerous methods have been evolved for treating milk so as to render it perfectly innocuous. Scalding or boiling are the most commonly favored means for destroying germs but heat destroys the character of the article and in artificially fed children it is invariably productive of rickets and other serious infantile maladies In pasteurizing milk no two dairymen adopt the same degree of temperature

Within recent years the tendency has been toward the use of a powerful antiseptic such as hydrogen peroxide. Although highly successful in its results, the use of antiseptics requires care, since otherwise the requisite effect is not achieved or the taste of the milk is quite changed A Danish chemical engineer C Budde, D.Sc, of Copenhagen, has for some time been prosecuting his investigation along these lines and after prolonged experiment has succeeded in evolving a process which has received the indorsement of such eminent bacteriologists as Prof Von Behring, Dr Rideal, Prof Tanner Hewlett, and other well known luminaries at the leading institutions of Europe. So effective is it in its application, that buddeized milk, as it is generically termed, is becoming extensively consumed not only in Denmark but other European countries and Great Britain

Although it appears somewhat elaborate in comparison with the popular dairy methods, the process is so inexpensive as to enable the purified milk to be sold at the customary price. The milk upon collection from the various farms is brought to a central depot, where it is raised to a temperature of 122 deg In this heated condition it passes through a centrifugal cleaning machine similar in design to a separator, but having only one outlet, the cream not being separated from the milk. This operation not only removes all particles of dirt suspended in the milk more effectively than ordinary filtering, but also serves to arrest any bacteria that may be adhering to the foreign articles and to the minute motes of the tissues of the cow which are always present in milk. It may be mentioned in passing that such cleaning the inventor maintains to be necessary in any milk treatment, since experiments have proved that the bacilli adhering to these different particles are the most resistant. Striking illustration of the extent to which dirt is present in milk is afforded by the amount of residue that is found in the bowl of the centrifugal cleaner after the raw milk has passed through

From the cleanser the milk passes into a water-jacketed glazed earthenware vat, in which it receives the predetermined quantity of hydrogen peroxide (H_2O_2) The temperature of the water jacket can be raised to the requisite degree and maintained thereat merely by the admission of steam The vat is fitted with a mechanical stirrer, which is actuated from time to time to create and maintain a homogeneous mixture. The peroxide is perfectly harmless when taken in small quantities. The amount used by Dr Budde is very minute The chemical is added to the fluid when heated to the temperature of 122 deg. F

The effect produced upon the milk by the hydrogen peroxide is that the enzyme catalase, first isolated by Loewe at Washington in 1901, attacks the hydrogen peroxide, and immediately decomposes it into water and oxygen. The result is that the one volume of oxygen thus released—hydrogen peroxide consists of two equal parts of hydrogen and oxygen—immediately seizes upon another atom of oxygen Consequently, for a very short moment the oxygen is in the form of unic atoms, and exercises a far greater inclination than ordinary oxygen to combine with the oxidizable substances present, which fact explains the well known powerful oxidizing qualities of the hydrogen peroxide. It is imperative that the H_2O_2 be chemically pure

The product has been subjected to prolonged searching tests by eminent Swedish, Danish Austrian and German scientists and bacteriologists, who have pronounced an eminently favorable verdict thereon Possibly the most striking of these investigations were those carried out by Dr Th Begtrup Hansen at the Silkeborg Tuberculosis Sanatorium in Denmark in comparison with raw and pasteurized milk. The results of those observations were completely satisfactory It was found that the patients partook of the buddeized milk readily and found it agree well with them, it was well absorbed and possessed good nutritive value, and in certain cases of gastric and intestinal disease agreed better with the patients than pasteurised milk, while no ill effects arose from the method of sterilization. Its greatest advantage, however, was its sterility, while the fact that it insured the destruction of tubercle bacilli in mixed milk from several cows, such as ordinarily exists in trade milk, i e., that generally provided for the public, was especially commented upon.

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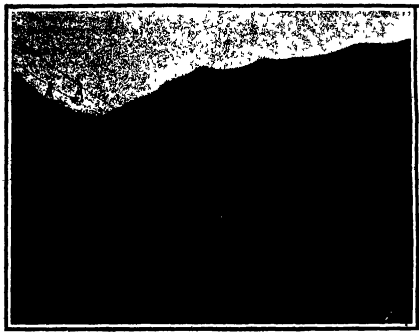
The wireless telegraph stations along the British coast established by the Marconi Company and the Lloyds have been taken over by the British Post Office, and hereafter will be operated by the government. The long-distance stations, however, at Poldhu, Cornwall, and Clifton are not included in the transaction and still belong to the Marconi Company This act of the British government will no doubt mark an important step in the commercial use of wireless telegraphy, because the Marconi Company has heretofore refused to communicate with vessels not equipped with the Marconi system of wireless telegraphy The British government will of course make no such distinction.

MOVING A MOUNTAIN IN UTAH.

One is accustomed to think of mining operations as being conducted deep in the bowels of the earth, and of miners working in cramped positions and an unwholesome atmosphere of powder-smoke and grime. In Utah, however, mining operations are conducted for the recovery of metal on a truly enormous scale, out in God's good air and sunlight, in the course of which a mountain is being leveled instead of caverns being hollowed out within the earth's crust.



Aerial cable tramway sending down to the railway ores from the Utah Apex mine.

One of the "benches" above the tramway shown in frontispiece of this issue

Nor are the unusual even sensational methods of mining adopted the only interesting features in the history of the Boston Consolidated and adjacent mines at Bingham Cañon, Utah In all the history of mining, always fascinating by reason of its surprises there is no story more romantic than that of the transformation of the Highland Boy on the verge of failure as a gold mine, into one of the largest copper producers of the world

The iron gossan outcrop in Bingham Cañon had long been a local landmark, and was known to contain gold to the value of $4 to $8 a ton but in a very refractory state, in 1895 the Highland Boy mine upon which considerable development work had been done, was offered for sale as a gold mine for $300 000 and refused after examination by a Montana syndicate Ten years later the Utah Consolidated Copper Company, with that mine as its principal asset, made a profit of $2,750,000 in a year, and is still making an increasing output.

Copper is the determining factor that has made all the difference

In 1896 Mr Newhouse secured sufficient capital to erect a cyanide plant, and the mine was a fairly profitable gold producer for a time, but profits dwindled and ceased, surplus capital evaporated and total failure seemed imminent, when toward the end of 1897, rock that was going over the dump as waste was found to contain 8 per cent of copper The lowest development adit had penetrated a large body of iron pyrites containing enough chalcopyrite to bring it up to the above value

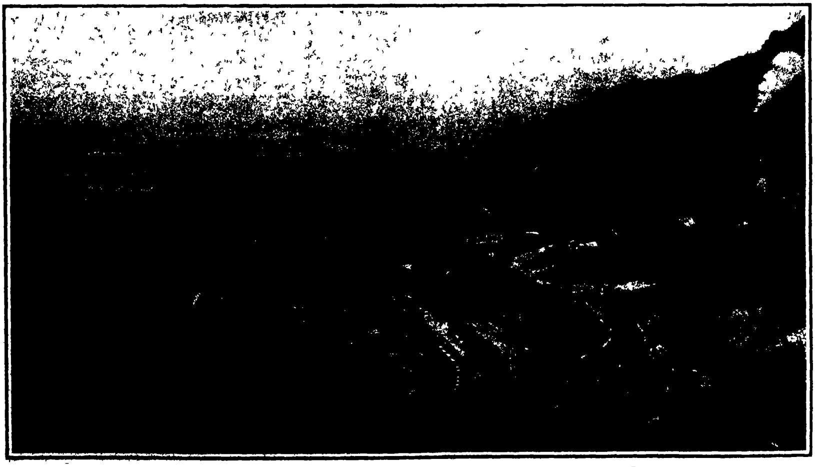
Prospecting in the same neighborhood by Col E A. Wall's associates disclosed a great laccolite of monzonite porphyry half a mile long and extending well up the mountain ridges containing—if everything assaying over 1 5 per cent copper is considered as ore—over two hundred and fifty million tons

The overlay of the Highland Boy sulphide deposit was also found to be largely impregnated with copper, and this led Mr Newhouse to acquire large holdings adjoining but not included in the combination owning that mine, now known as the Utah Consolidated Copper Company Prospecting on these revealed an enormous lenticular deposit of copper sulphide formed by replacement in limestone and even this was not the limit, later investigation showing hundreds of acres of old igneous intrusive monzonite to have been impregnated with copper solutions possibly by the same later eruptive action as caused the replacements

This forms the property of the present Boston Consolidated Copper Company and the mountain now being moved as shown in our front page illustration

Operations were commenced upon the underground sulphides assaying as much as 8 per cent of copper, but it was at first a question whether the higher impregnations could be mined at a profit Ore carrying as little as 1 per cent had been profitably mined at the Atlantic in Michigan but that was native copper whereas the Bingham deposit was all sulphide On account of the latter being so readily accessible however practically no shaft sinking or pumping being required it was very cheaply mined and with the present stripping methods breaking enormous quantities of rock at very low cost a handsome profit over mill and smelter costs is shown

The solid sulphide ore mined below still pays for the operations on the mountain top, ore being stoped



A great smelter at Garfield, Utah, built especially to treat the ores excavated at Bingham Cañon.

MOVING A MOUNTAIN IN UTAH.

from three underground levels in a deposit at some places 100 feet wide. The ore is discharged from the upper to the lower levels by chutes, and from the lowest directly into cars of the "high line" of the Rio Grande Western, which convey 750 tons daily from the Boston Consolidated to the smelter of the American Smelting and Refining Company at Garfield.

The stripping operations at the top of the mountain began with the removal of waste rock overlying the enriched monzonite, the ground having been leached of its values to a depth varying from 30 to 60 feet. This waste is carried round the mountain and dumped on the far side, where the ore body lies lower and could not be eventually mined by removal of the overlay. Now, however, sufficiently rich ore to be sent to the mill is being stripped in the same way and sent down by the tramway shown in our illustration, the whole of the rock exposed by each blast being carefully sampled and assayed and sorted accordingly.

For the stripping operations five steam shovels were first sent up the mountain by a specially built railroad with numerous switchbacks.

The hilltop is laid out in four benches from 40 to 120 feet high, the highest bench being kept farthest back, so that rock blasted there does not fall upon and impede the tracks upon the bench below. Well drilling machines are used to drill 5 inch holes 30 feet apart in a line as far back from the face of each bench as the explosive will break. When the holes reach the level of the bench below, they are pumped out and "sprung" with 25 sticks of 40 per cent dynamite, again with 50 sticks, and sometimes again with 75 or more. This makes a chamber at the bottom of the hole large enough for the breaking charge, which is from 20 to 60 boxes of powder per hole. A row of holes is fired simultaneously by electricity, and the whole face of the bench is moved and shattered so that it can be handled by the steam shovels. On the average 2.8 tons of rock is broken per pound of explosive used, and 0.68 ton per foot of hole drilled. Masses too large to be handled by the shovels are drilled with percussion or air hammer drills and split up.

Each of the shovels is of 90-ton capacity with a 5-ton dipper. Two trains of wooden dump cars attend each shovel, and the latter fill the 4 ton cars at the rate of about one a minute. Four shovels, each working two shifts of ten hours, have handled 14,000 tons in a day, making 175 tons per hour each. The cost of excavation has been as low as 12 cents per ton of ore delivered in the cars, including explosives, labor and shoveling.

The ore selected to go down to the mill is dumped by the cars in a 100 ton receiving bin at the top of the incline shown in our illustration, which feeds it into the 12 ton skips of a balanced gravity tramway. The latter has two pairs of tracks 2,100 feet long descending the hillside at a gradient varying from 23 deg. to 27 deg. The skips discharge about 150 tons per hour into the steel tank receiving bin at the foot of the tramway, having a capacity of [illegible]000 tons, which discharges directly into the railroad cars of the high line.

The smelter at Garfield shown in our illustration was built especially for treatment of the ores of the Boston Consolidated Utah Copper Company and other mines of the neighborhood, after contracts had been made with them providing for a certain constant supply.

On account of the mountainous and irregular nature of the ground, aerial cable tramways are found to be the cheapest means of transporting the ore in some cases, that of the Utah Apex mine being shown in one of our illustrations. In these, buckets suspended from rollers travel upon a fixed cable supported on towers, the buckets being clamped to an endless traveling cable passing round drums at the head and foot of the line, the weight of the loaded buckets descending carrying up the empties on the other side.

From present indications only the price of copper can limit the alteration of the horizon in Bingham Cañon, the time being measurably distant when the gulches will be filled up with waste rock and the mountain top reduced to about their level.

A NEW AUTOMATIC ELECTRIC SIGNALING SYSTEM FOR RAILROADS.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN

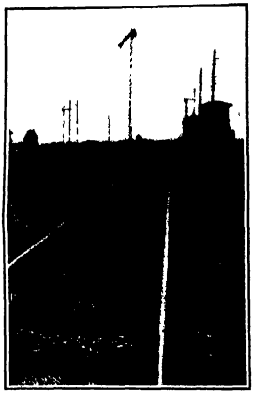
An important development in automatic signaling for railroads has recently been introduced in Great Britain by the Great Western Railroad, the foremost trunk line in the country. Despite the elaborate nature of the block system, and the strict rules laid down in connection with its working, several accidents have recently occurred in the country owing to the ordinary semaphore signals, especially those at the distant point, being inadvertently overrun by the engineer, more particularly in the case of express trains, the mishap being due to the signals being obscured by fog, snow or rain. Notwithstanding the excellence of the block working, this dependence upon the human element has proved its weakest link. The Board of Trade department of the government, which is responsible for insuring the safe operation of railroads, has long advocated the adoption of an automatic signaling system whereby the engineer is given on his engine not only a visual but also an audible indication of the condition of the section upon which he is entering at any time, since it is realized that the momentary occupation of the engineer's attention to any other detail on the locomotive at the instant of passing a signal might easily jeopardize the safety of his train.

The Board of Trade officials have subjected the latest idea, which has been adopted by the Great Western Railroad, to the most severe and exacting tests, and although it is valuable as an auxiliary to the ordinary semaphore, it can be safely operated without the latter, and as a result of their investigations have conceded to this railroad permission to remove their semaphores and operate a section of their track solely upon this new system, which concession is the first that has ever been granted to any English railroad, and consequently marks an important era in the safer working of railroads.

The system adopted is entirely electric, there being no mechanical parts, such as triggers, to come into contact, so that no concussions can result which might imperil the durability of the invention. Upon the locomotive is carried a downward projecting shoe, similar in design to that utilized upon street railroad cars to collect the current from the feed rail, and this shoe comes into contact with a long section of ramp laid between the tracks, thereby establishing electrical communication, and notifying the engineer in the cab both visibly and audibly whether the section of road he is entering is blocked or clear. These audible signals comprise a steam whistle or siren, which is sounded to notify that the signal is at "danger," while "line clear" is signified by means of an electric bell. Either of these signals, when once set in action, continues to sound until it is stopped by the engineer, so that the latter must inevitably realize the condition of the track by stopping the whistle or bell, thereby accepting the warning extended to him. Both signals are given by the operator in the signal cabin to the engineer without the movement of any apparatus on the track, this latter constituting a fixed ramp. Moreover, should there be any breakdown in the electric circuits a danger signal is conveyed to the engineer whether the road is clear or otherwise, so that his attention is drawn to the fact instantly. Also, should the insulation of the ground apparatus be broken by the presence of grease, dirt, snow, water, etc., so that the electric circuits cannot be connected, the danger signal is instantly sounded. In addition to the siren and electric bell placed in the locomotive cab, there is an indicator extending corresponding visual signals, the danger signal being represented by the word "danger" printed on a red ground appearing in the glazed aperture of the indicator, while "line clear" is represented by a clear white space. It will be realized therefore that much of the value of the system lies in the fact that the danger signal is operated whenever any untoward circumstance exists, such as apparatus breakdown, disturbed insulation, etc., whether the line be clear or *vice versa*.

Immediately beneath the cab of the locomotive is placed the shoe (in the accompanying photograph the tender of the locomotive has been removed to show its position), which comes in contact with the fixed ramp, during the passage over which it is lifted. The normal position of this shoe is 2½ inches above rail level, but when passing over the ramp, owing to the latter projecting some distance above rail level, it is raised about 1½ inches. This contact shoe is of stout construction and is capable of adaptation to any type of engine. The contact face is 7 inches wide and it is case-hardened. There is a strong spiral spring provided which insures the shoe returning to its normal position directly it leaves the ramp. This shoe is insulated from the mass of the engine, and the caution signal is operated by the disruption of a local electric circuit on the locomotive. In its normal position the shoe serves to complete this electrical circuit, but directly it is raised, as when passing over the ramp, and even if only raised ⅛ inch, the circuit is broken. The result of this circuit interruption is that a steam whistle is brought into action which has previously been held closed by the circuit.

In connection with the whistle and bell signals, an indicator board is attached at the side of the cab. There is a large slot before which appears the notification "Danger" upon a red ground when the signal is against the engineer, giving way to a blank white space when the line is clear, these two notifications coinciding with the whistle and bell signals respectively. Thus the engineer is given a clear positive visual warning in addition to the positive audible signals. The push button shown on the side of the indicator is that by which the engineer stops the ringing of the bell, and the lever the means by which the steam whistle is closed. The ramp is laid down at the point where the distant signal is desired to be given, and, if the semaphore is still to be retained, is installed beside it, centrally between the running rails. It comprises a bar of T iron mounted and insulated upon a timber base, and is bolted to the cross-ties to insure rigidity. Upon tracks upon which fast-running trains are maintained the ramp is made 60 feet in length; while for branch lines a 40-foot length has been found to be sufficient.



Section of track provided with central ramp.

Rear view of locomotive, showing contact shoe.

A NEW AUTOMATIC ELECTRIC SIGNALING SYSTEM FOR RAILROADS.

* * *

The cause of the disappearance of rust from iron bars, etc., used in the erection of reinforced concrete structures, has been traced by Rohland,' in Stahl und Eisen, to the presence of acid carbonates and sulphates in the cement, these salts dissolving the iron oxide and leaving the metal bright. The cement in setting absorbs carbonic acid from the air, thus forming the necessary acid carbonates, and experience has shown that the de-rusting process is effected while the concrete is setting and commencing to harden. This discovery affords an additional guarantee for the safety of reinforced concrete structures, inasmuch as the metal is protected from rusting by the alkaline reaction of the cement during the mixing process, and any rust on the bars is removed by the action of the acid carbonates at an early stage in the erection of the structures.

THE VESSEL THAT ACCOMPLISHED THE NORTHWEST PASSAGE.

BY J. MAYNE BALTIMORE.

The Norwegian seventy-five-foot sloop "Gjöa," which is famous the world over for having been the first and only craft to have threaded its way through the Arctic Ocean from the north Atlantic to the Behring Sea, is now the property of the city of San Francisco. Capt. Roald Amundsen, the noted Arctic navigator, sailed from Christiania, Norway, with a crew of seven in the year 1903, and after nearly three years he succeeded in reaching Nome City by way of the Northwest Passage. From there he sailed his little vessel out into the Pacific, and thence down the coast to San Francisco harbor Later he returned to Norway, leaving the "Gjöa" at the Mare Island navy yard. The little craft was turned over to the Norwegian consul at San Francisco by his government, with instructions to make whatever disposition of this historic vessel he deemed best. The consul finally concluded to present the "Gjöa" to the city of San Francisco in behalf of the Norwegian government, to be preserved as a relic and souvenir of the feat of Capt. Amundsen in making a voyage through the Northwest Passage.

THE "GJÖA" BEACHED AND ABOUT TO BEGIN ITS "INLAND VOYAGE" TO GOLDEN GATE PARK.

The city authorities gladly accepted the gift of the famous old craft, and decided to place the vessel in a conspicuous position at the extreme western confines of the Golden Gate Park just bordering on the ocean beach.

The "Gjöa" was fitted into a cradle of wood, and loose dry sand filled in all around up to the waterline. The work of hauling the old sloop out of the sea up the beach for a height of more than 40 feet and several hundred feet across the big boulevard to the point where it is mounted in permanent position proved a very heavy and difficult task of engineering. Several days were required to accomplish this work

The total weight of the empty hull of the "Gjöa" is estimated at 300 tons. The total length over all is 75 feet, length of waterline, 65 feet, beam, 16 feet, depth of hold, 16½ feet. The "Gjöa" was not primarily intended for Arctic navigation When purchased by Capt. Amundsen, the vessel was reinforced with stout wooden and iron beams and sheathed with an outer layer of 2-inch planking and fitted with a petroleum engine of 39 horse-power and a two-bladed propeller However, sails were depended upon as main motive power

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A TAME NAUTILUS.

BY CHARLES F HOLDER.

The accompanying photographs show a paper nautilus which was so tame that I could handle it with impunity The animal was brought to me without a shell, and I provided it with one.

The beautiful animal seized upon it with all the eagerness of a homeless hermit crab, occupying it at once. When alarmed it would crouch low, its entire body and tentacles drawn into the shell; nothing but the green eye to be seen peering over the edge. Then, when satisfied that all was well, it would gradually come out, changing tint and shade of blue all the time, presenting a most interesting spectacle. Now the two large shell-forming arms would creep out and slowly envelop the shell, until it was entirely covered by the speckled blue mass. The animal would do this even when I held the shell. The animal did not display any fear, and would throw its tentacles about my fingers, and even leave the shell and permit me to handle it. This is well shown in the illustration, where the animal is leaving the shell which I am holding. Its big blazing silver shell-making tentacles are being thrown over my hand, while the other arms are toying with the weed at the bottom.

The dark spot in the center is the mouth, or the black mandibles surrounded by a white circle of muscle. In another view the animal is seen entirely out of the shell, its mouth near my thumb one long tentacle thrown across my fingers, while the big spreading tentacles of silver and blue are being waved aloft like brilliant Venetian banners The eye is shown as a pure white spot just below the mouth and near the large gill openings Below this hangs the bag like body When I withdrew my hand the nautilus fastened itself to the glass sides of the tank and hung a glistening mass of color, scintillating in the light Not one person out of a thousand could even guess what it was. Even teachers of zoology when the shell was taken away, failed to recognize it, and there was some reason as this was the first opportunity they had had to see the animal really alive By placing a cloth over the tank and raising and lowering it the nautilus could be made to change its color

SCENES IN THE LIFE OF A TAME PAPER NAUTILUS.

If the broad tentacle is examined it will be seen to have radiations which correspond to those of the shell itself It also bears numbers of glands, and clings tenaciously to any object it may touch These tentacles are the shell makers, and part of the work in shell making was observed in a specimen that had no shell. Resting on the bottom, it held its two shell secreting arms above side by side, in point of fact, they were joined at the base Then from the glands oozed the shell-making secretion and it soon appeared as a gelatinous cast of each tentacle, the exact size of the shell the animal had been inhabiting

The radiation on the face of the tentacles match the radiations on the shell and one could imagine that gelatin had been pressed into the molds and allowed to harden, and this is practically what is done The two molds (tentacles) are held up close together, the left one forms the left side the right one forms the right side. Then by manipulation they are joined together Indeed the two tentacles have been joined all the time, and so form a mold in which the beautiful shell or egg capsule is made I watched this radiant creature all day and late into the night and the following morning part of the new shell was found a delicate tenuous mass that would gradually harden Hence I believe that a new and large shell can be produced in a few hours and nearly a whole one was made by this animal in the Avalon zoological station between 1 o clock in the morning and 9

It is given in all the textbooks I believe that the male of the argonaut is a minute animal hardly an inch long This cannot be so in all species I have a male which has a radiant spread of eight or nine inches and is as large as the female The female lives in the shell and deposits her eggs here—yellow masses which hang in the shell I saw her leave the shell and wander about at will darting into it when alarmed and having practically all the habits of an octopus The male of this species is large and might readily be taken for an octopus having its habits The beautiful animal appears at the Southern California channel islands especially Santa Catalina in February and August from ten to twenty shells being found every year Doubtless hundreds come ashore but are deserted and broken

The argonauts that I have kept in confinement three in number were extremely interesting They would eat fish from my hands readily and displayed little or none of the timidity of the octopus When alarmed they would dash away filling the water with ink and propelling themselves by the siphon out of which they sent water with such force that when held above it the stream would go five or six feet through the air I noticed that the octopus tried to use this as a defense as when I moved my hand near its egg cluster it would direct the siphon at me and shoot a stream with such force that it was easy to see that small enemies at least would be blown away

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The Grand Trunk Pacific Railway (Canada) has commenced a novel undertaking whereby a record of the growth of the West so far as the railway is a factor in its growth will be kept The official photographers of the company have begun to work on the plan of the company and towns along the line will be photographed each photograph being duplicated yearly so that a continuous record may be obtained and kept of each individual town from the time it sprang up throughout the period of its growth The record kept is expected to be of invaluable importance in years to come

◆

In British Columbia platinum is found in many of the alluvial gold workings where it can be saved as a by product The saving of it in a small way is however attended with so much trouble that it has been practically neglected and no appreciable production made recently

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

BURIAL ROBE.—C I Owen, New York, N Y The aim of this invention is to provide a construction which will enable collars of different styles to be used with the same grave clothes and which will also enable the collar to be readily attached or detached to and from the clothes and around the neck of the body

Electrical Devices.

ARMATURE J P Nickonow Evansville Ind The invention relates to armatures of a type suitable for dynamos and motors, the particular purpose being to render the armature strong and durable and especially braced against the influence of centrifugal force It relates to means for improving the circulation of air adjacent to the armature in order to prevent overheating of the windings thereof

ELECTRIC THERMOSTAT—J R Carlenter Hancock, Mich The invention pertains to electric thermostats the more particular purpose being to provide a construction in which the action is alternative, that is to say either an increase or a decrease in the temperature beyond a predetermined limit will cause an alarm to be actuated

Of Interest to Farmers.

HAY RETAINING DEVICE FOR HAY STACKERS—J O McCaffrey Fort Morgan Colo In a well known apparatus a series of parallel teeth are pivoted to a head forming part of the stacker frame which rests on the ground Hay is carried up to the stacker and deposited by a sweep rake The teeth of the stacking apparatus are provided with pivoted fingers for retaining the hay deposited thereon said devices being adapted to release the hay when the teeth are raised for throwing the hay backward The invention is an improvement in construction and attachment of the hay retaining fingers

SEED DRILL G W Nation Alliance Neb In operation the framework being drawn through the field the disks which are provided with radial sickle shaped blades stir up the soil and prepare it for being furrowed by furrow openers of the drilling attachment. The rotation of the dropping wheels permits the grain to move in predetermined and regular quantities through shoes into the furrow and the shoes may be adjusted to any position by a handle

CORN HANGER F F Swanson Galesburg Ill The invention is an improvement in corn hangers for hanging ears of corn for use as seed corn or otherwise Brackets are arranged in pairs and consist of two wires loosely wound at their middle portions side by side around the round part or bearings, usually two full turns with their free ends bent upwardly to receive the ears and when in use the brackets are turned on the round portions to space apart the adjacent arms. It is suspended by a hook.

Of General Interest.

TRESTLE—R J Koch New York N Y The improvement is in trestles of a folding or knock-down type for general use where such an elevated support is required, and has in view a trestle preferably in the main constructed of sheet metal, providing a relatively strong structure which when disassembled may be packed within a space approximately not larger than the trestle beam

SHIPPING CASE C C Hotchkiss Great Bend Kan The invention is adapted to various kinds of shipping case devices and relates primarily to the corner connections between the several walls of the case the same being so constructed as to permit of the rapid and convenient assembling and disconnection of such parts and producing when erected, a case capable of withstanding rough usage

SEPTIC TANK A W Hitshman Staunton Ill The tank is for use in sewage disposal in which the sewage is partly purified by means of fermentation or putrefaction in which the passage of sewage therethrough can be readily controlled which permits it to escape in case the outlets are clogged so that the material backs up within the tank and which is provided with manholes, and manhole covers so that the tank can be tightly closed, while access can be easily had thereto

HATCH A N McGray Boston Mass This hatch cover can be securely battened down upon the hatchway to prevent water from entering the hatch if the vessel is laboring in a seaway so that waves break upon deck or to prevent the escape of liquid from within the vessel where a hold section has become filled by accident or serves as a container for liquid in bulk or is filled with liquid for ballast or stability purposes which can be easily manipulated and in which dead space under the deck is reduced to a minimum.

GAGE FOR DEEP-SEA SOUNDINGS—J Mel and T Jones Jr Calveston Texas. One purpose of the invention is to provide a liquid gage or recorder for deep sea soundings, so constructed that it will contain no moving parts and so that its action is both positive and direct and so that the instrument can be used an indefinite number of times without any delay

BOTTLE WRAPPER E C Rinner, Coshocton, Ohio. The invention pertains particularly to that type of wrapper which is formed of corrugated cardboard or pasteboard. The improved construction tends to distribute the pressure when a number of articles covered by the wrappers are packed in a shipping case.

CEMETERY STRUCTURE—G C Simpson West Newton Mass The invention refers to reinforced concrete and provides improvements in cemetery structures, such as mausoleums memorials burial vaults and the like whereby the structure is rendered exceedingly durable and fireproof, can be cheaply erected, and enables the builder to provide any architectural features and an unlimited variety of designs and appearances.

Hardware.

CURRYCOMB—A C Ditmar, Davenport, Wash This currycomb will be substantially self-cleaning that is, it is constructed in such a way that when pressure is removed cleaning devices which are attached to the sides of the teeth will move down toward the points of the teeth in such a way as to clean or wipe them

NUT LOCK—W E Fraser, Perham Minn. In this invention the object is to provide a device simple and efficient in construction and inexpensive to manufacture which will effectively lock a nut in place on the shank of a bolt against accidental displacement, and which can be readily loosened by hand.

TOOL-GRINDING APPARATUS—G W Riddle, Breckenridge, Mo. A leading feature in this invention is the arrangement of the three hollow legs composing the frame in such convenient relation to the shaft of the grinder proper that one serves as a support for the said shaft and another as a guide and protector for a retracting spring connected with the shaft

SOLDERING DEVICE—F S. Chapman Kenton Ohio. The invention provides improvements in means for use in soldering metallic parts and is especially applicable to those joints used in electrical constructions which require a good metallic contact in order to provide against undue resistance to the electric current in the conductors at their point of union

OILSTONE HOLDER—F J Bador Brooklyn N Y and C L Carer, Salfords, Horley Surrey England In general this invention consists of a relatively long bar provided with a handle and having a tool seat on one face extending in the direction of its length preferably V shaped in cross-section and a spring to bind on the inner end portion of the tool and force the tool to the seat adjustable along the length of the member

PROCESS FOR THE MANUFACTURE OF A MIXTURE OF GAS AND AIR FOR ILLUMINATING PURPOSES—F W Wolff, Berlin Germany This process is for use in the production of a gas and air mixture for illuminating purposes there being a connection with the pipes of a gas work and employing a suction and forcing apparatus which produces and sucks the mixture at low pressure and feeds it at an increased pressure to the consumption place.

Heating and Lighting.

GAS-PRESSURE REGULATOR—J G Wilson, New York N Y This gas pressure regulator is for use in the service pipe between the gas meter and the burners, and is arranged to insure uniform pressure at the burners, to render the regulator exceedingly sensitive, and to prevent the working parts from sticking

DRIER—J M Urquiza, Baracoa, Cuba The drier is intended more especially for coffee and similar materials. It consists of a section oven each section divided into drying compartments, each compartment having a track therein a truck movable over the track having containing drums, with the axes extended through a plate which forms the front of the compartment and carries means for driving the drums steam coils arranged in the compartment under the drums and means for introducing hot air jets over the drums.

MANHOLE AND BONNET FOR PIPES AND FURNACE-CASINGS—E. Pankenborg, Syracuse N Y An object of this invention is to so construct the cover or bonnet for closure of an opening formed in a hot air furnace wall or a hot air pipe that the material removed in the formation of such an opening will be used in the production of a bonnet or cover therefor and thus economize material.

Household Utilities.

STOVE.—F Madsen Wilbur, Wash. The present invention has for its principal objects the following first, to increase the available radiating surface in a stove second to cause the heated gases to maintain closer and more intimate contact with the metal of the radiating surfaces third, to regulate the output in heat of the radiator

COMBINED NAPKIN RING AND HOLDER W L Barnard Halstead Kan. The intention here is to provide a ring and holder simple in construction and inexpensive to manufacture which can be used to hold a rolled napkin when the latter is not in use, or which can be converted into a holder for securing the napkin in position upon the body of a person during meals.

STOVE.—E C Cole, Chicago, Ill. The invention comprises a plurality of series of fire bricks arranged one series above the other, and a series of spaced apart vertical draft columns between the bricks and extending across the joint between the series of bricks, and provided with openings, the columns operating to hold the bricks in place.

CHAIR—I Mason, New York, N Y This chair is capable of being converted for various uses. The invention consists in a device comprising an arm chair having a removable seat that can be so fitted to the arms and back as to cover the intervening space and provide a table bounded by the upper contour of the chair

Machines and Mechanical Devices.

STAVE-CUTTING MACHINE.—M. C. Thoeschmidt, New York, N Y The object of this inventor is to provide a new and improved stave-cutting machine, arranged to quickly and accurately give the desired shape to the stave both as to the longitudinal contour of the side edges as well as the bevel thereof and without requiring handling of the material.

AUTOMATIC LOCK FOR HOISTING APPARATUS—R. M Rodgers, New York, N Y The invention appertains to an improved locking device for hoisting appliances, more especially dumbwaiters, in which relation it automatically operates under the tendency of the load to lock the car in any position of its movement immediately after the pull on the hoisting wheel ceases.

GUIDE ATTACHMENT—H Holmes Duffey Cal The main purpose here is to so construct the guide that the cable may be readily removed therefrom without disassembling the device and a further important object is to so connect the body of the device to the stationary support that it may freely rotate in respect thereto but cannot become detached therefrom

GOVERNOR—G H Wilson, Spokane, Wash The object of the inventor is to provide a new and improved governor, for use in automatically checking the speed of automatic fire escapes and other machinery requiring a steady uniform motion When the machine again runs at a normal rate of speed the piston is returned to its normal position by the action of a spring

WASHING MACHINE. J D Williams Clay City Ky In this case the purpose is to provide novel details of construction for a washing machine, which embody reciprocating rollers with a corrugated spring-pressed plate in the suds box, and other novel features that co-operate and together afford a simple very effective and convenient machine

LOCK FOR DAVITS—W J Ryan and L Tanning New York, N Y The invention refers to davits and associate mechanism for handling small boats on shipboard. The invention comprehends a davit including a staff which may be turned for the purpose of handling a boat the limits of the turning being adjustable at will

DISPENSING MACHINE. P C Petersen, Perth Amboy N J The invention is an improvement in machines for dispensing cigarettes and matches or similarly shaped articles and has in view an apparatus to be actuated by a check or coin-controlled mechanism and which will deliver a cigarette and a match at each operation.

FLYING-MACHINE—W H Martin Canton Ohio. Two general principles are comprehended in this invention one serving to effect an automatic adjustment of an aeroplane to such an angle to the horizontal as to cause it to have a buoyant tendency from the resultant upward pressure against its lower sides. The other serving for the automatic balancing, or self righting quality of the aeroplane as against tendency to dip sidewise about its axial line of flight

ELEVATOR W T Long, Sumner Wash. In this elevator Mr Long provides a carriage a frame being provided to travel in guides in the carriage a yoke being disposed in the frame two clamps being pivoted to the yoke, the clamps being also pivoted to the frame, the means being provided to limit the movement of the yoke and to move the frame relatively to the carriage

OIL-FEED FOR DRILLS.—M Gallowics, New York N Y The object of this inventor is to provide means for feeding oil through the bit of the drill to its cutting point. More specifically the device embodies an oil head which is formed above the drill chuck, and this oil head is provided with means for controlling the flow of oil from the reservoir through the oil duct which is formed longitudinally in the drill.

PUMP—F Foley, Crowley La The valve in this case comprises a series of members arranged in superimposed position, adapted to seat, one above the other, effecting closing position and at the same time being adapted to lift or be lifted to opening position. The valve is designed for use upon a pump piston having an opening vertically therethrough

FEED MECHANISM FOR TUBE CUTTERS.—W Cushing, Claysville Pa The object of the invention is to provide a feed mechanism for feeding a mandrel used for forcing the cutting wheels of the revoluble cutter outward in a gradual but positive manner to insure the proper cutting of the cutting wheels without danger of injury to the same.

Prime Movers and Their Accessories.

VALVE-GEAR.—T O'Brien, New York, N. Y More particularly stated the invention comprises a construction whereby certain movable valves actuated periodically by push rods are readily disconnected from the latter and from their housings, and thus removed from the engine and easily replaced within the engine by reversing the steps necessary to remove it.

Railways and Their Accessories.

COMPRESSED-AIR SIGNAL.—R. Armstrong, Victoria, British Columbia, Canada. Particularly stated the invention comprehends a whistle operated by compressed air from the signal pipe, and valve mechanism controllable by variations in the pressure of air within the signal pipe for controlling automatically the supply of air to the whistle.

DELIVERY APPARATUS.—H B Murray, Jr, Portsmouth Ohio. More particularly the invention relates to apparatus adapted to be used in connection with railroads or the like, for delivering messages and dispatches. It can be used for delivering messages from a car to a point alongside a track or *vice versa*, and is so constructed that one or more messages can be delivered without the necessity of resetting the apparatus.

RAILWAY-CUSPIDOR.—W Hill, Albany, N Y The invention relates to certain improvements in cuspidors especially designed for use in railway cars or other vehicles, and one object is to provide a device which may be readily moved about to bring it to the desired position and which will automatically drain to the exterior of the car

BOX-CAR DOOR—W T Anfield, St Louis, Mo. The invention is an improvement in the class of doors for box freight-cars and other inclosures, which are adapted to roll parallel to the side of the car or inclosure, for covering or uncovering the doorway For convenience in moving the door it is provided with a handle arranged adjacent and parallel to the curved or contact portion of the door-rail

Pertaining to Recreation.

DEVICE FOR ASSISTING IN THE SHOOTING OF MARBLES.—H O Hughes Slatington Pa The aim in this case is to provide a cap which is adapted to be disposed on the thumb of the player, the cap having an outwardly disposed stud intermediate of its ends, which is adapted to engage a marble when it is held between the finger of the player and the cap covering the player's thumb

Pertaining to Vehicles.

BRAKE FOR VEHICLES—A P Peabody, Camp Verde Ariz. Ter The inventor provides a construction for a brake wherein the wearing shoe may be quickly and readily replaced; provides a holding device for securing the wearing shoe to the brake which will not become loosened and provides a construction for securing the wearing shoe to the brake which is strong, durable and simple

VEHICLE WHEEL.—L Ingram and C M. Hart, Amityville N Y By this invention the inner tube of an ordinary pneumatic tire may be eliminated and a substitute support the wheel and hold the outer casing in extended position A plurality of cylinders and pistons within the tire are so mounted and disposed as to resist not only pressure radially of the wheel, but also side thrust or diagonal strain

SPRING WHEEL.—F N Ginn Little Rock, Ark. The invention is especially useful in connection with automobiles motor trucks, and the like. The wheel has resilient means for absorbing shocks from the irregularities of the road, and thus obviates the use of the pneumatic tire and the objections incident to such use

WIND-SHIELD—E Flagg, New York, N Y A wind shield constructed in accordance with this invention and formed of two sections, one of which is foldable to a position adjacent the other section, may rely solely upon the action of gravity to retain the movable section in either of its two positions, which is not ordinarily possible with a shield held in a vertical position

VEHICLE WHEEL.—D I Palmer, Chelsea, Mass. One object here is to provide a vehicle wheel with two rims which are separated and held normally in their relative positions by springs and guides, which will not only permit the outer rim to move toward the inner rim and thus furnish the resiliency desired, but will also permit the outer rim to rotate slightly, relatively to the inner rim and thus furnish additional resiliency

STEERING MECHANISM—A Mauksch, near Tabor S. D This mechanism can be used with the usual steering knuckles found on automobiles, so as to bring about a greater displacement of one of the two steering wheels than the other The purpose of this is to displace the wheels so that their axes of rotation will intersect in the plane of one of the hind wheels. In this way the turning of the vehicle is made to take place about that hind wheel as a center

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

Die Flugmaschinen Theorie und Praxis. Berechnung der Drachenflieger und Schraubenflieger Von Georg Wellner, Maschineningenieur, Hofrat, Professor i R. Mit 100 Abbildungen und 2 Tafeln Vienna A. Hartleben, 1909

The author of this book has had about thirty years' experience in the solving of aerodynamic problems. As a general rule, aeronautical works are either entirely practical or purely theoretical in other words, they either simply describe machines that have been actually constructed, or else set forth with the aid of complex mathematical formulæ the theoretical problems involved in aerial flight. The book before us is unique in so far as it is a compromise It is both a practical and a theoretical treatise As to mathematics, the author has purposely avoided the usual analytical method of discussion, which provides for all contingencies and which considers not only uniform horizontal flight but accelerated flight and flight on an inclined plane and has concerned himself chiefly with the synthesis of convenient and easily understood equations for those simpler cases of aerodynamics which agree fairly well with practice Therefore, not a few mathematical formulæ will be found in the book, Nevertheless, the work may be regarded as a semi popular treatise Approximations and abbreviations have been adopted perhaps too liberally but inasmuch as the aim of the author seems to have been clearness of expression and a simple explanation of the principles of dynamic flying, his course seems to be justified An excellent discussion of the relative merits of aeroplanes and helicopters or screw fliers will be found in the work On the whole the tone of the book is healthy It is free from that exaggerated optimism which has led the public to expect more from the future of artificial flight than past failures would seem to justify

A History of New York Shipyards By John H Morrison, author of 'A History of American Steam Navigation" New York William F Sametz & Co 8vo, 165 pp, 20 ill Price, $2 50 net.

The name of John H Morrison as the author of anything connected with the history of shipping particularly in New York city and vicinity is a synonym of great accuracy and thoroughness of research and these qualities are evident in the compact work before us In his 'History of American Steam Navigation' Mr Morrison has given the public a very exhaustive summary of the ships built and their subsequent performances Of equal value and interest is the story of the New York shipyards in which these vessels were built It was only during the later history of colonial times that vessels began to be built in this city for the coastwise and the West Indian trade and the material for the history of the shipbuilding of those days is very scanty After the signing of the treaty of peace with Great Britain the shipbuilding industry began to show indications of its subsequent great activity which became pronounced after the monopoly of steam navigation on our rivers was removed in 1824 Then came the building of the ocean and coastwise steamships and later still of the justly celebrated clipper ships. It was not until the close of the civil war that a marked decline began to occur in the shipbuilding of New York city The work opens with a survey of the colonial period followed by a chapter which carries the story to the year 1820 and contains an interesting account of the early American New York ships and shipbuilders including the 'Clermont' and its constructor Charles Browne who, by the way was born in London and served for some time in the British dockyards Subsequent chapters deal with periods of large development in shipbuilding the strikes of shipyard employees and the formation of trade unions, the famous 'Mechanics Bell" whose purpose it was to give regular notice when to commence and when to quit work the new era of ocean steamships, which culminated in the magnificent clipper ships of worldwide fame, the launching of vessels and launching disasters high water in wooden shipbuilding a most interesting chapter containing new information about the yacht 'America" and the records of prominent American clipper ships and finally, a chapter on the decline of wooden shipbuilding This is a most excellent work upon a too-much-neglected subject

Inventions, Patents, and Designs By G Croydon Marks. New York D. Van Nostrand Company, 1909 16mo, 116 pp. Price, $1

In this book Mr Marks has printed in full the British Patents and Designs Acts of 1907, and has in connection therewith devoted many pages to a popular discussion of the questions which patent solicitors are continually required to answer In this way much information is compiled in convenient form for reference.

A Guide to the Country Home. By Edward Kneeland Parkinson. New York The Outing Publishing Company, 1909 12mo, 156 pp. Price, $1

This well printed little book deals with Choosing the Home, Winter Planning; Tools, Their Cost and Use, What Shall We Raise; Live Stock—the Horse; Cows, Their Cost and Care; Swine, the Curing of Hams and Bacon; Fowls, Their Care, Cost, and Price; Crops and How to Plant Them, the Orchard; the Market Garden; the Kitchen Garden; Bees, Trees, Lawns, and Shrubbery and the Harvest The illustrations are printed on woodcut paper and are inserted.

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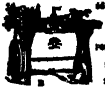

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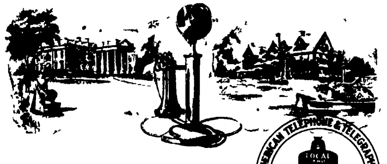

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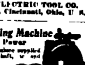

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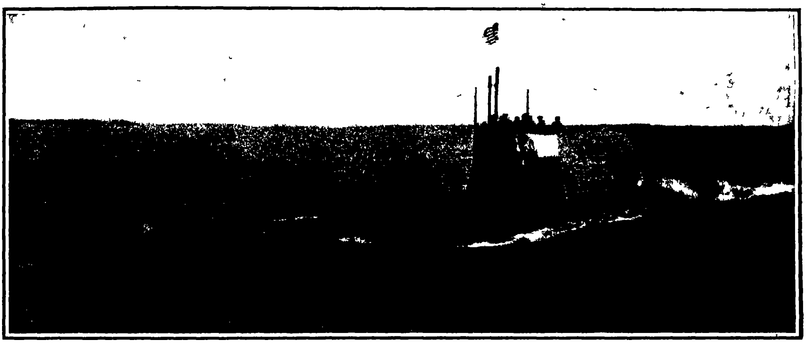
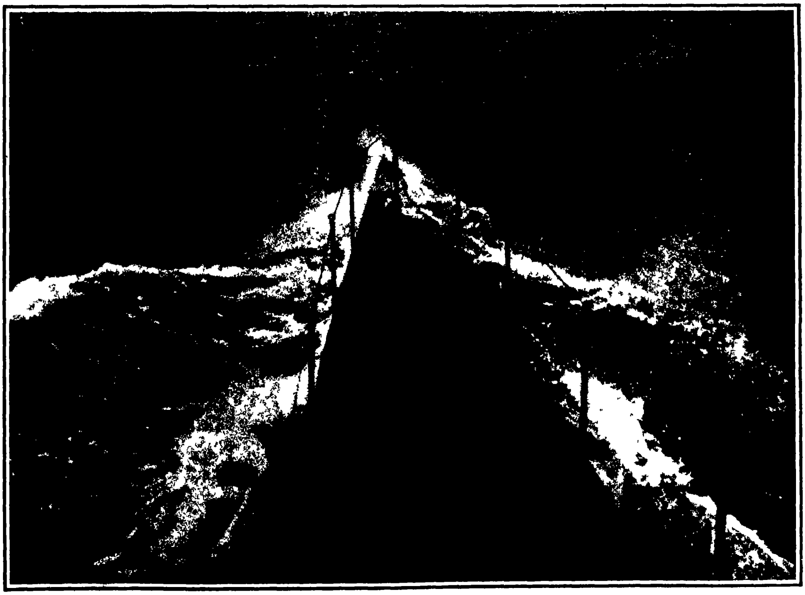


At the surface the vessel is driven by her internal-combustion engines at a speed of 14 knots.

The "Narwahl" cruising at the surface.



View looking forward from the bridge. Taken when the "Narwahl" was making 14 knots at the surface. Before diving the stanchions, handrope, removable navigating bridge, steering wheel [illegible] are unshipped and passed below

THE "NARWAHL," LATEST AND LARGEST OF THE UNITED STATES SUBMARINES.—[See page 296.]

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NEW YORK, SATURDAY, OCTOBER 23rd, 1909

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

A TALK WITH WILBUR WRIGHT

"No. The next advance in the art of human flight will not be so much in improving the motor as in the practice of high flying Personally, I am perfectly satisfied with our motor, not that one, but the later type, which has been strengthened in the very part where the cylinder gave way just now ' Thus Wilbur Wright. It was in the gathering gloom of an October afternoon, and we were standing alone in the shed which had been built on Governor's Island to house the Wright aeroplane during the late Hudson Fulton Celebration. A few minutes earlier the machine was on its launching ways, with everything primed for an hour-long flight in which Wright had purposed to travel up the East River, over the four [illegible] that span it, across Manhattan [illegible] over the Hudson and the Palisades and return to the starting point with a wide detour over the Jersey Meadows and across the Upper Bay We had seen Wright and his mechanic crank the engine by a swift turn of the propellers, had heard the loud explosion and crash, as the forward cylinder tore loose from the crank case, and had seen the wrecked cylinder tear its way through the upper plane and fall at Wright s feet. At the very moment when a million people were lining both shores of the Hudson River, watching with absorbing interest to catch the first glimpse of the author and past master of the art of human flight lo' here was his machine rendered an absolute wreck, and the possibility of a Hudson Fulton flight shut out for good' Under such dramatic conditions of disappointment a Frenchman would have wept. Not so Wilbur Wright. Picking up the broken cylinder he turned to the small group of which the writer formed one, smiled gave an almost imperceptible shrug of his shoulders, and quietly remarked, It is all over, gentlemen "

If there is any appetite for the sensational or melodramatic in Wilbur Wright, he certainly keeps it under masterful control The fact that he had been opposed to the giving of public exhibitions of flight, and that this was the first and only exception that he had made, would for most men have rendered the complete breakdown of his machine a most aggravating disaster Yet five minutes later, when we were alone with him and his disabled air craft, he was perfectly composed, and showed his philosophical estimate of the true significance of the mishap by pointing to the broken cylinder and remarking "This is merely an incident. The machine is an old one that I used at Kitty Hawk The metal was rather light at the point of fracture The defect has been remedied in our later motors '

A few months ago we expressed the opinion in these columns that the element which needed most attention in the aeroplane was the motor and that until the latter had been brought up to the degree of reliability of the automobile motor, the art of flying could not make much material progress Wilbur Wright however does not agree with us. "I have developed my motor to the point at which it has ceased to give me any more anxiety than the motor of an automobile I have run the later pattern of this motor in an endurance test (not of course in the air) for seven consecutive hours, and my machines have made 250 consecutive flights without experiencing motor trouble "

"In what direction, then, will the development of the future be made?" we asked, and again the answer came back 'High flying, we must get up clear of the belt of disturbed air which results from the irregularities of the earth s surface. From now on you will see a great increase in the average elevation at which aviators will make their flights, for not only will they find in the higher strata more favorable atmospheric conditions, but in case of motor trouble, they will have more time and distance in which to recover control or make a safe glide to earth "

Next we raised the question of suitable starting and stopping places, and suggested that the art of flying was handicapped by the present necessity for broad open spaces for the purpose This brought the reply that since trains, trolley cars, steamboats and sailing yachts are all provided with special points of departure and arrival, it was a little unfair to quote the necessity for such conveniences as an objection to the aeroplane But the problem of alighting, especially during a cross-country flight is not so serious as you might suppose It will be largely solved by the high flying to which I referred just now for, the greater the elevation, the larger the section of country from which the aviator can select a suitable alighting place Suppose," said Wright, "in making a flight, say of 100 miles, I rose to a height of one mile and that while at that elevation motor trouble necessitated an immediate descent. Commencing to glide down the air on a grade of one in seven, I would traverse seven miles of country in a straight line before reaching the ground, that is, supposing that the ground were fairly level But the glide could be made in any direction, and consequently I could choose a landing place on any one of the 150 square miles that would be included in a circle of 14 miles in diameter The chances would be therefore decidedly in my favor of finding some fairly smooth field, free from obstruction, on which I could come down safely "

Of course the question of speed came in for discussion, and the reply to the question whether we shall see any great increase in speed in the near future was characteristic 'Why should we wish to increase the speed? It was only a few years ago that the world believed the construction of a successful flying machine to be impossible and yet there are not many birds that I cannot overtake with that machine " This was presenting the speed question from a new and very sensible standpoint for it must be admitted [illegible] surpassed the average speed of the birds thus early in the game is one of the most sensational achievements of this the latest and most sensational of man s inventions.

THE NEW BRITISH "DREADNOUGHTS" AND "INFLEXIBLES."

Rather complete particulars have lately been made public of the latest British "Dreadnoughts" and "Inflexibles ' which are now being built in government and private dockyards Taking the "Neptune" as the latest representative of the Dreadnought' type in the British navy, we find that the length has been increased by 20 foot and the beam by 4 feet, and that the displacement has been increased from 17,900 tons to 20 000 tons The speed, 21 knots, remains the same and no changes of any consequence have been made in the disposition of the armor for the protection of the hull or the barbettes and turrets.

The most important changes—those which serve greatly to increase the power of this ship as compared with the original 'Dreadnought"—relate to the armament In the Dreadnought," it will be remembered ten 12-inch guns were mounted in the following positions Two on the forecastle deck, a pair on each beam amidships on the main deck, with the superstructure between them and four in two turrets on the main deck astern and on the center line of the ship This plan has been changed in the Neptune" by placing the two wing turrets *en echelon* or diagonally, with sufficient distance between them in the fore and aft direction to permit the guns of both turrets to fire on the same broadside Another change is to raise these two turrets and also turret number 4, one deck higher, placing them at the same elevation as the forward turret The aftermost turret will be located, as in the "Dreadnought," on the main deck. By this redistribution the 'Neptune" can fire six guns ahead, eight astern, and ten on each broadside, as against six ahead and astern and eight on each broadside, in the original "Dreadnought." The "Neptune' will carry a new 50-caliber, wire-wound 12 inch gun, and not, as reported, a 13 5-inch gun. For torpedo attack a battery of 4 7 inch guns will be mounted in a lofty central armored redoubt surrounding the smokestacks, which will protect both the guns and the smokestack bases.

The improved Inflexible" known as the "Indefatigable," has 25 feet more length, 2 feet more beam, and 2 000 tons additional displacement than Admiral Seymour's flagship The speed is the same, but the extra 20 feet of length will enable the midship turrets to be placed farther apart in the fore and aft direction than they are in the "Inflexible," with the result that the broadside angle of fire of what might be called the "off turret," that is to say, the turret which is on the side of the ship remote from that on which an engagement is taking place, will be greatly increased

Great Britain evidently is well pleased with her 26 knot battleship cruisers of the 'Inflexible" type, for she is now preparing to lay down on the ways vacated by the 'Indefatigable" another ship of the same type but of far greater dimensions. She is to be 600 feet in length, and equipped with turbine machinery of even greater horse-power than that installed in the "Lusitania" and "Mauretania." As these liners exert over 70,000 horse-power when they are making their maximum speed of 26 knots, it can be understood that to secure the 28 knots required in the new cruiser battleship, the horse-power must run up to 80,000 or more It is probable that the vessel, on her trials, like her predecessors of the 'Inflexible" class, will exceed the requirements by about a couple of knots. The "Inflexible" and her sisters made 28 knots over short distances, and it is likely that the 600-foot ship will be able to carry her battery of eight 12 inch guns for a short spurt across the high seas at a speed of 30 knots an hour, which is higher than the average speed of the torpedo-boat destroyers.

SOME PHOTOCHEMICAL REACTIONS.

A quantity of benzaldehyde, inclosed in a sealed glass tube and exposed to light, is almost entirely converted into a red brown, transparent resin which, when treated with ether leaves a small quantity of a crystalline residue, fusing at 475 deg F and identical with the trimeric modification into which benzaldehyde is converted by the action of iodobenzol.

The resin deposited by the evaporation of the ether from the ethereal solution yields, on distillation, benzoic acid, hydrobenzoin, and unaltered benzaldehyde, and leaves a resinous residue which has the percentage composition, but four times the molecular weight of benzaldehyde, of which it is probably a tetrameric form It may however, be a ketone, of the formula $(C_6H_5)_4\ (CO)_2\ (COH)_2$.

Dibenzyliden acetone in alcoholic emulsion exposed to light for a year yields di-isosafrol in addition to the molecular weight of the ketone.

Isosafrol mixed with a trace of iodine and exposed to light for a year yields di isosafrol in addition to a large proportion of resin but safrol is unaffected by light Analogous results are obtained with methyleugenol and isomethyleugenol Propenyl compounds are found to be more affected by light and more readily converted into polymeric forms than members of the allyl group The action of light on mixtures of benzaldehyde with safrol and isosafrol produces resinous substances which, when purified and analyzed, prove to be simple addition products.

THE SPECTRUM OF MARS.

A bulletin has recently been issued by the Lowell Observatory in which the results of Mr Frank W Very's quantitative measurements of the intensification of great B in the spectrum of Mars are given The general result of the investigation is that the great B in Mars is 15 per cent stronger than in the spectrum of the moon at the same altitude, and that B in the spectrum of Mars is relatively more intense by eight times the probable error of the result. Mr Very states that while there is considerable variation, there are no contradictory results. In Mr Very's opinion the measurement proves beyond a doubt, that it is possible to discriminate differences of a few per cent in the intensities of spectral lines, although it would take much wider variations to attract the attention of a casual or even of a careful observer, if deprived of such assistance as can be given by the spectral band comparator In his recent Mount Whitney studies, Prof W W Campbell, of the Lick Observatory, stated that the A band was faint in both the lunar and solar spectra when the bodies were low, fainter when the bodies were higher, and very faint when the bodies were at their highest, but for equal altitudes, the A band in the Martian and lunar spectra were equally intense, plainly signifying that the observed bands were due to water vapor in the earth's atmosphere above the summit of Mount Whitney Here is obviously a conflict which must be settled before we know definitely whether or not the spectrum of Mars does contain water vapor

* * *

In the Revue de la Soudure Autogène, Bournonville describes a method of repairing cracked iron pulleys by local heating The crack in the rim is opened by means of an expansion screw acting on the two adjoining spokes, so as to make a gap about 1/16 inch to 1/24 inch in width Welding metal being then melted in the crack by means of the oxy-acetylene flame, the expansion screw is withdrawn quickly, while the metal is still red hot, and the elastic pressure of the rim counteracts the contraction of the joint in cooling. No special care is needed in cooling, and the metal can be tempered without risk of cracking.

AERONAUTICS.

[illegible] Dumont has been making excellent cross-country flights near Paris of late with a new monoplane fitted with a 24-horse-power double-opposed-cylinder motor. The machine complete weighs only 242 pounds. The Clement company is building a number of these machines, to sell for about $1,250 each.

The second Aeronautic Show to be held in Paris opened in the Grand Palais on September 25th and lasted three weeks. This exhibition demonstrated how the aeronautic industry has advanced by leaps and bounds within the year. Some thirty different aeroplanes and a score of aeronautic motors were shown, as well as one small dirigible and several plain balloons. A complete description of the show will be given in next week's SCIENTIFIC AMERICAN SUPPLEMENT

Before starting to teach Lieutenants Lahm and Humphries the operation of the recently acquired government biplane, Wilbur Wright tried the machine out on October 9th and had his pupils time him for a distance of a kilometer in a closed circuit. This distance, including the turn, was covered in 48 3/5 seconds, or at a speed of exactly 46 miles an hour Allowing 100 meters extra for the turn, the speed was 50 miles an hour Thus it seems that the new government aeroplane is quite as fast as the Bleriot or Curtiss machines, which made over 47 miles an hour at Rheims.

With the great aviation meet at Rheims as model, almost all the other large cities on the Continent have arranged for a similar event. After Brescia (Italy) and Berlin, Spa, Boulogne, and Dieppe in France, Frankfort in Germany, and Blackpool in England have put up large cash prizes to secure Latham, Bleriot, Farman, and some of the less well known but fully as daring aviators. The Frankfort authorities even went so far as to pay the traveling and hotel expenses of the "bird men." A big meet was held at the new Juvisy aerodrome near Paris from the 7th to the 21st of this month, no less than 37 machines being entered of which 13 were Voisin biplanes On October 10th thousands of people flocked to Juvisy The train service was inadequate and there was such a demonstration by the crowd that the troops had to be called out.

On October 13th a course of lectures upon aviation to be given by Wilbur R. Kimball was inaugurated at the rooms of the Young Men s Christian Association, 318 West 47th Street, New York city Besides Mr Kimball's lecture, which was illustrated with a number of models, Mr Hudson Maxim, the inventor of maximite and an authority upon explosives spoke upon the dropping of explosives from aeroplanes. He thought the public should be rid of the fallacy that much harm can be done in this way The aeroplane, he believes, will be used for scouting and raiding but not as an instrument of destruction in itself Mr. Winthrop E Scarritt, an ex-president of the Automobile Club of America, gave an interesting talk on the future of aeronautics.

In connection with the Centennial Celebration at St. Louis, Glenn Curtiss made a number of short but good exhibition flights There was also a balloon race on the 11th instant, in which 10 balloons competed. The "St. Louis III.," piloted by Louis von Phul, won, covering 545 miles in 41½ hours duration, and landing at Lawrence, Minn. The "Indiana," with H H. McGill pilot and J M. Schauer aide, landed near Albany, Minn., 500 miles distant. Mr McGill was taken violently ill, and his aide was finally obliged to bring the balloon to earth to get medical assistance. The "Centennial," H R. Honeywell pilot, made a flight of 480 miles and landed at Silas, Ala. The "Cleveland," J Wade, Jr, pilot and A. H. Morgan aide, covered 450 miles and landed near Alexander City, Ala. Baldwin, Knabenshue, and Beachy also made flights at the celebration in their dirigibles. Messrs. Post and Harmon, in the "New York," won the endurance race in 48 hours 26 minutes.

The third international balloon race for the Bennett trophy started from Schlieren (near Zurich), Switzerland, on Sunday, October 3rd. There were 17 starters representing 9 nations and divided as follows America 1, Austria 1, Belgium 2, England 1, France 3, Germany 3, Italy 2, Spain 1, Switzerland 3. For the second time in four years the cup was won by an American, Mr. E. W. Mix, of Columbus, Ohio—our sole representative—having the good fortune to travel over 648 miles in 35 hours, and, after passing through a drenching rain and having some exciting experiences in the Bavarian Alps, to finally land in the trees in the forest of Gutova, some miles north of Warsaw in Russian Poland. Mr. Mix and his aide were obliged to throw out their life preservers and provisions in order to keep afloat so long. After doing this at Breslau early Monday afternoon, they rose to a height of 9,000 feet, from which elevation they gradually fell until the balloon landed at 8 A. M. October 5th. Second place went to Alfred Leblanc with a record of [illegible] miles.

ELECTRICITY.

The New York Public Service Commission reports that 3,237 persons were injured last August on the surface traction lines of New York city This is 12 less than the record for August, 1908. The serious injuries for this August were 204, or 32 less than for the corresponding month of last year

The Canadian Pacific Railroad has found the telephone so serviceable for train dispatching that the present system of about 500 miles of telephone lines will be extended to 1,000 miles within a year The company states that about fifty per cent more traffic can be handled now than was possible under the old telegraph system of dispatching

Every once in a while we hear of wireless telegraphic communication over an enormous range Recently the army transport "Buford," while nearing Honolulu, succeeded in exchanging messages with the Pacific coast. The distance covered was 3,500 miles. This does not mean that there has been a wonderful advance in wireless telegraphy, but merely that atmospheric conditions were unusually favorable.

The electrification of the street railway line from Woolwich Arsenal to the London County Council free ferry has been brought to a halt owing to possible disturbance of the delicate instruments at Greenwich Observatory The Astronomer Royal has the power to stop any undertaking within three miles of the observatory that is liable to affect the instruments, and the railroad company must obtain his consent before proceeding with the electrification

Manufacturers of electrical apparatus have recently awakened to the fact that there is quite a demand for a transformer which will permit of operating electric bells, buzzers, toys, etc., with current taken from line circuits in place of storage or primary batteries. Small direct-current battery apparatus may ordinarily be operated on an alternating current without any change in the windings or connections, provided the voltage is sufficiently reduced A transformer of this type has recently been put on the market, which will reduce from 110 volts to from 8 to 26 volts.

A very ingenious method of overcoming the friction of intermeshing gears has recently been devised The gear teeth are electromagnetically held in engagement, without actually contacting The teeth of the driving gear are magnetized by means of suitable coils, while the teeth of the driven gear serve in pairs as armatures for the magnetized teeth Of course such an arrangement would hardly be suitable for slow, heavy work, because the cost of current would be greater than that of lubricating oil and the loss due to friction but for light, high-speed work the electromagnetic engagement would undoubtedly prove very advantageous

Portable telephone instruments are being made by the Western Electric Company for use on interurban electric railways The telephone instruments are carried on the cars, and stations are located at various points along the line. The conductor or motorman can connect the instruments to the station by merely inserting a pair of line plugs, and thus can get into direct communication at once with the dispatcher In case of delay on the road, or an accident these instruments are invaluable, as they enable the dispatcher to learn the particulars at first hand, and make arrangements to relieve the situation

An apparatus for sterilizing water has recently been put on the market in France in which ozone is used to destroy the bacteria. The ozone is generated by means of electric discharges, and the gas is introduced into the water by means of an aspirator The ozone is led into a mixing tube screwed to the water faucet, and the water is forced by a small pump through several compartments, so that it is divided into a number of fine jets. In this way an intimate mixture of the gas and water is obtained The device is so arranged that the ozone is generated only when the faucet is opened

A large electric freight locomotive is being built for the New York, New Haven & Hartford Railroad, with which it will be possible to test thoroughly the advantages of handling freight trains electrically The locomotive will also be used for hauling heavy passenger trains. Following the present tendency, the motors are placed above the axles, thus raising the center of gravity and reducing the shocks and strains to which the roadbed and track are subjected by locomotives in which the motors are mounted on the axles. The locomotive is mounted on two trucks, one of which is pivoted on a center pin, while the other has a fore-and-aft movement as well as a pivotal movement, permitting it to negotiate curves. Four 350 horse-power single-phase motors are used, which may be operated either with 11,000-volt alternating current or 600-volt direct current. A flexible connection between the power and the wheels is accomplished by gearing the motor to a quill on the axle which is provided with driving arms that project between the spokes of the wheels. These arms are connected with coil springs, which serve to absorb shocks and strains of transmission and equalize the torque on the gears.

SCIENCE.

The Cook-Peary controversy will probably be settled by a commission of inquiry appointed by Dr Ira Remsen. The commission will examine and report on the Arctic records, observations, and data collected by both explorers.

Boomerangs are now made of celluloid and hard rubber Celluloid is better than cardboard because it is waterproof, light, very hard to break, and can be worked into the peculiar curve and twist so necessary to give the boomerang its peculiar properties.

The owners of a St. Abbs fishing boat have made the important discovery that a net dyed as nearly as possible the hue of the sea instead of the traditional brown yields much larger results in the matter of fish caught. The discovery was says the Western Morning News put to the test a short time ago when, out of a fleet of sixty-five boats the boat with its nets dyed blue made far and away the largest catch. The dye used is bluestone. The discovery has aroused much interest among the fishermen.

Peat, as it comes from the bog, contains from 85 to 95 per cent of water According to Dr Ekenberg it appears that the peat contains a hydrocellulose which is of the nature of a jelly If the peat is subjected to pressure the hydrocellulose passes through very much as soft soap might, and without separating the water from the peat If, however the peat is heated to about 320 deg F this jelly is immediately destroyed, and most of the water can be separated by a pressure of about 240 pounds per square inch

The steamer 'Conqueror' at Leith has been chartered by Dr W S Bruce Edinburgh the leader of the recent Scottish National Antarctic Expedition for the purpose of undertaking another expedition to the polar regions The expedition it is expected will be ready to sail in a little more than a fortnight. The present intention is that the expedition will be away for two or three months Important observations in the neighborhood of Spitzbergen are premeditated Dr Bruce being a recognized authority on that region

A process has recently been patented by two Italian gentlemen for rendering calcium cyanamide inoffensive At present this product has several serious drawbacks owing principally to its causticity, and the ammonia and hydrocyanic ethers which it gives off. The process in question proposes to add sulphuric acid diluted with its weight in water to the cyanamide, after introducing the cyanamide in small quantities to the liquid, the whole should remain slightly acid After an intimate mixture the product is dried at 40 to 50 deg C, and then pulverized.

The following experiment, writes Mr C S Jackson, in Nature, is easily tried and throws some light on a certain type of illusions A small cogwheel from an old American clock is the only apparatus required Holding the axle in the finger and thumb of the right hand, give it a twirling motion say counterclockwise Let the teeth of the wheel click gently against a small card, or the finger nail of the left hand On looking at the wheel the spokes appear to revolve counter-clockwise (as they do) and the teeth to revolve in the reverse direction

Radium appears to have a marked action on the development of the eggs of the *Philine aperta* M Jan Tur, of Paris, made a series of over forty experiments with a very strong radio-active preparation about 9 milligrammes of radium bromide acting through a thin glass plate upon the eggs in different stages. In the first stages of development the eggs do not seem to suffer from the effect of the radium but after a certain period it is found that the organs will no longer be formed A longer exposure causes the larvæ to shrink up and they become only one-fifth of their normal size. After 6 to 9 days there remains nothing but a shapeless mass of cells and the mass is observed to have a rapid rotary movement inside the shell of the egg The larvæ are found to die in 9 or 10 days after the laying of the eggs without being able to leave the shell

The occurrence of ores of tungsten in Canada is the subject of a report by Dr T L. Walker recently issued by the Canadian Department of Mines After pointing out that the metal is used not only in the manufacture of metallic filament electric lamps but also in the production of tungsten steel and of the tungstates which are employed as a mordant in dyeing in giving weight to silk goods, and in rendering cotton goods fireproof he goes on to give particulars of the chief tungsten ores, their geological occurrence and the methods used in treating them, as well as some statistics of the world's production of them which has been advancing rapidly of late years He then gives a detailed account of the occurrence of such ores in Canada, and finally remarks that, though no tungsten production has yet been credited to the Dominion and that she has no well-developed and established tungsten ore mines, still there are many districts where such ores occur.

THE FIRST GERMAN MONOPLANE TO MAKE SUCCESSFUL FLIGHTS.

Our illustrations show the monoplane of Herr Grade, who is the first German to make successful flights in a heavier-than-air machine. This monoplane resembles that of Santos-Dumont in its general make-up, the aviator being placed below the plane, and the motor—a 4-cylinder air-cooled engine of the V type—being located at the front edge, and carrying a propeller on its crank-shaft The wings of the monoplane are set at a slight dihedral angle, and are provided with a flexible edge at the rear A tail with vertical and horizontal surfaces is mounted upon a bamboo pole extending out behind.

While making an attempt to win the Lanz prize of $10 000 at the Mars aerodrome near Berlin, Herr Grade experienced a bad fall, fortunately without injury The flight required was one of 2½ kilometers (1.55-mile) in the shape of a figure eight. The aviator made a splendid start, but in the middle of his flight, when at a height of nearly 100 feet, the propeller broke, and the machine came forcibly to the ground Fortunately, the shock of striking the ground was lessened by the alighting of the monoplane in some low pine trees. The machine was badly damaged but Herr Grade expected to repair it in a few days.

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THE AVIATION MEET AT BERLIN AND LATHAM'S FLIGHT ACROSS THE CITY

The aviation meeting which was held recently at Berlin was specially noteworthy for the great feat of Hubert Latham in flying across the city of Berlin from the Tempelhofer field to the aerodrome at Johannisthal. This flight was made on September 27th, the second day of the meeting, and it has already been mentioned in these columns. Our photograph shows the machine as it flew across the sheds which were erected for the aeroplanes at Johannisthal. The great height at which Latham flew is indicated by the small size of the monoplane, which looks like a huge bird of prey winging its way in the upper air Latham made the flight of 6¼ miles across the city in less than 10 minutes. He first made two circuits of the Tempelhofer field and then started straight off across the city at a height of about 300 feet As soon as word was received by the waiting spectators at Johannisthal that Latham had started they all strained their eyes in an effort to see the machine in the distance. Soon it appeared a mere speck in the sky It came rapidly nearer, and finally passed overhead as shown in our illustration Before coming to earth, Latham completed two circuits of the aerodrome, a distance of about 12½ miles. Upon alighting, he received a decided ovation The total length of his flight was about 24 minutes.

The opening day of the meeting Sunday September 26th, was not very auspicious Baron De Caters made several circuits of the 2½-kilometer (1 55 mile) course, and Bleriot did likewise. Neither aviator kept aloft long enough, however, to qualify for the speed prize. Leblanc started on his Bleriot monoplane, but only succeeded in making a half round of the course

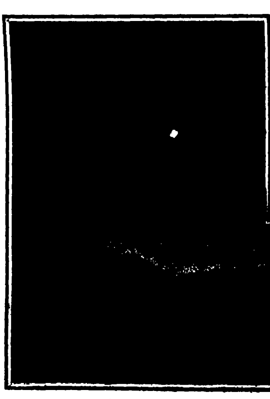
On September 27th very little was accomplished, but the following day several excellent attempts were made to win prizes, the best of these being that of Rougier who flew 44 75 kilometers (27 78 miles) in 52 minutes Latham and Farman both attempted to win the speed prize. The former covered the required distance of 20 kilometers (12 42 miles) in 18 minutes 4 2/5 seconds, and the latter in 20 minutes 9 2/5 seconds. M Bleriot did not quite succeed in completing the 20 kilometers. Rougier in his long flight, attempted to win the height prize presented by Count Zeppelin, but he only reached a height of 100 meters (328 feet). Edwards, who was operating a Voisin biplane, had a bad tumble after completing three circuits of the course. He fortunately escaped with only a few slight cuts. Baron De Caters damaged his biplane in making a sudden landing

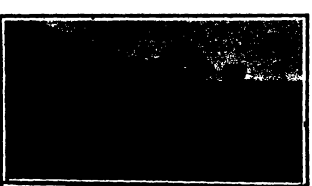
On September 29th, Rougier made 31 rounds of the course, and covered an official distance of 77½ kilometers (48.12 miles) in 1 hour and 37 minutes, a speed of 28.73 miles an hour Latham covered 67½ kilometers (41.91 miles) in 1 hour and 14 minutes. His average of 41 22 miles an hour in the 20-kilometer speed test caused him to be declared the winner of the speed prize of $2,000 On October 1st Rougier won the distance prize of $10,000 for 2-hour 41 minute 50-second flight, in which he covered 80¾ miles at an average speed of 30 miles an hour

M Bleriot's monoplane was attached by the management when the champion aviator attempted to leave with it for Cologne. He had been paid $5,000 to fly at Berlin on five days, and because he refused to stay, his machine was retained. M. Leblanc also stopped when Bleriot quit. On the whole, this meeting was fairly successful, especially in view of the fact that it was run during the time of the aeronautic show at Paris, which opened on September 25th. Latham struck the ground forcibly in one of his landings, breaking a wheel and damaging his propeller as shown in one of our photographs.

This is the first German aeroplane to make satisfactory short flights.

THE GRADE MONOPLANE IN FLIGHT





Front view of Latham's monoplane, showing damage sustained in alighting.

The arrival of Hubert Latham at Johannisthal after his flight across Berlin.

In this instance for the first time an aviator arrived at an aviation meeting on his machine, after taking a direct air line.

THE AVIATION MEET AT BERLIN AND LATHAM'S FLIGHT ACROSS THE CITY

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Holland compound is a solution of 5 parts of soda water glass and 1 part of carbonate of soda, or a powder mixture consisting of 3 parts of calcined soda and 1 part of dry potash water glass. Ten parts of this mixture is said to be sufficient to render 100,000 parts of hard water soft.

Suicide of Scorpions.

The venoms of serpents, fishes, scorpions, centipedes, spiders, bees, etc., as well as the blood of the eel, owe their virulence to the presence of toxins similar to those which are secreted by bacteria. In both cases the toxins are specific products of the activity of living cells. They are very poisonous, non-crystallizable colloids, of unknown chemical constitution. The venom toxins are very sensitive to the action of heat and light, are easily destroyed by digestive ferments, and consequently are innocuous when swallowed. There is a great variety of these toxins. One poison alone contains half a dozen distinct toxins, each of which exerts a specific action on the nervous system, the red or the white blood corpuscles, etc.

It is possible to produce in any animal an artificial condition of immunity to the effects of any animal venom This is accomplished by the repeated injection of the venom in doses, each of which is too small to cause death. After a larger or smaller number of injections the animal acquires the power to resist the action of many times the quantity of venom that would suffice to cause death, if it were injected into the veins of a non immunised animal. The blood of the immunised animal now contains a new substance, an antitoxin which has the property of neutralizing the toxin of the venom, and this blood (or rather its watery part, or serum) may be employed to combat the toxic action of the venom in a non-immunised animal.

The ichneumon, the hedgehog, and some other animals which devour venomous serpents, exhibit an extraordinary resistance to the effect of their bites. This natural immunity is explained by the presence of antitoxins in the blood of these animals. Serpents are also little affected by their own venom In general, it is almost impossible to kill a venomous animal by inoculating it with the venom of its own species, of which it can support very large doses with impunity

These facts demonstrate the absurdity of the stories of rattlesnakes and scorpions committing suicide by means of their own venom. It is asserted that a scorpion or a rattlesnake imprisoned in a circle of red-hot coals will sting or bite itself to death. This is a physiological impossibility.—Cosmos.

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Common iron scrap has now so low a commercial value that it is hardly worth the trouble of selling, unless it has accumulated in large quantities. But there is a difference in scrap, as the following story proves. A French ship recently sailed from Oakland, Cal for Genoa, with a cargo of iron scrap collected from the ruins of San Francisco, after the earthquake and conflagration of 1906. The scrap is consigned to the Italian government and is to be used in the construction of a warship of the "Dreadnought" type. It appears that a small lot of similar material, which was brought to Genoa two years ago and mixed with steel, produced armor plates of unusual strength. In consequence of this result, which was due to the intense heating which the scrap had experienced in the conflagration, the Italian naval engineers advised the government to purchase all the scrap iron from the San Francisco fire that could be obtained

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The United States Treasury Department will soon take up the subject of providing sanitary paper money. Not the least of the reforms proposed is the proposition to wash national bank notes. It is said that the idea of washing bank notes is by no means infeasible, for it is possible by means of a chemical solution or bath to clean the notes without injuring the [illegible]

A SIMPLIFIED METHOD OF TEACHING EXPERIMENTAL PHYSICS.

BY JACQUES BOYER.

Until recently, experimental physics has been taught by rather superannuated methods in the lycées and colleges of France The teachers lacked simple apparatus suitable for the initiation of their pupils into the mysteries of acoustics optics, electricity and magnetism although some of the schools possessed magnificent instruments copies of those of half a century ago which in the language of M Chassagny the inventor of the apparatus described below were a joy to their makers but of little use to their possessors There were costly Hero s fountains and Morin s machines which were used only once a year The pumps and hydraulic presses were equally expensive and they gave the pupils a totally false conception of the pumps and hydraulic presses employed for practical purposes Babinet s improved pneumatic apparatus is remarkable chiefly for its great display of polished copper The Gay Lussac eudiometers Ramsden electric machines condensers of Aepinus Watts s machines and many others have now only historical interest For several years French teachers of physics have been trying to modernize their cabinets of apparatus and to modify their instruments in order to simplify experimental observations Prominent among these progressive teachers is M Chassagny inspector of the Academy of Paris who has invented a number of efficient instruments of neat and substantial though inexpensive construction with each of which various instructive experiments can be performed

Fig 1—The mechanical recorder.

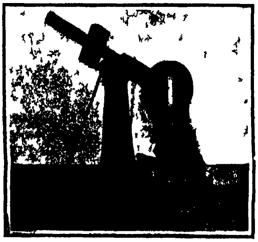

Fig 6.—Chassagny's apparatus for electromagnetic induction

The complicated machines of Atwood and Morin for the study of the laws of falling bodies are replaced by the mechanical recorder (Fig 1) which is useful also in explaining the laws of the compound pendulum and the graphical method of recording movements in general. A bicycle wheel is mounted with its axle horizontal in a flat wooden frame The rim of the wheel carries a wide band of sheet brass forming a sort of drum which can be covered with a band of smoked paper and one end of the axle bears a small grooved driving pulley The center of gravity can be brought accurately to the axis of rotation by means of sliding weights attached to two of the spokes At one side of the drum a short pendulum formed of a heavy cast iron cylinder is mounted on an axis perpendicular to that of the drum on the blackened surface of which a record is traced by a flexible needle attached to the pendulum The drum and the pendulum can be stopped together or separately by means of an adjustable lever and the driver is also provided with an emergency brake

Fig 2.—Apparatus for combining vibrations in the same plane

With this apparatus some fifteen experiments can be performed illustrating the static equilibrium of moments inertia the action of constant forces the law of velocities proportionality of force to acceleration resistance of the air friction isochronism of small oscillations the graphic method of registering movements etc

In demonstrating the principle of inertia the needle is brought into contact with the band of smoked paper carried by the drum and the drum is turned The pendulum being in the position of equilibrium the needle traces a line which when the paper is removed and laid flat will be straight and will constitute a base line This line having been traced the pendulum is drawn to one side a rotary impulse is given to the drum with the hand the pendulum is released by moving the lever which holds it and the needle traces an undulating line The distances between consecutive intersections of this line with the base line represent equal intervals of time corresponding to equal vibrations of the isochronous pendulum and as these distances are also found to be sensibly equal in length the experiment proves that the drum set in motion by a momentary impulse continues to rotate with practically uniform velocity (the effect of friction being negligible)

In studying the action of a constant force the base line is traced as before A cord is then wound round the drum and a weight of about one-quarter pound is attached to its free end as shown in Fig 1 The zero point is marked by allowing the pendulum with its needle to swing across the base line while the drum is held at rest The pendulum is then drawn aside and by a proper adjustment and manipulation of the lever the pendulum and the drum are released simul

(Continued on page 304.)

Fig. 4.—Chassagny's [illegible].

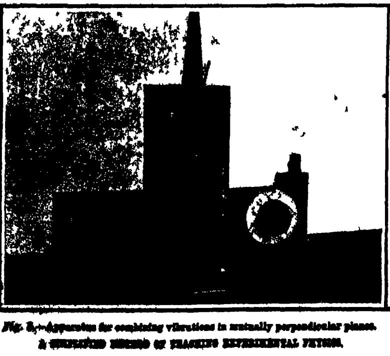

Fig. 3.—Apparatus for combining vibrations in mutually perpendicular planes.

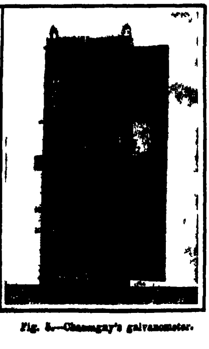

Fig. 5.—Chassagny's galvanometer.

A SIMPLIFIED METHOD OF TEACHING EXPERIMENTAL PHYSICS.

A New Process for Developing Photographs in Daylight.

If an ordinary dry plate, after it has been exposed in the camera, is placed in a bath of potassium iodide, the silver bromide is converted into the non-sensitive iodide and the latter can then be developed in daylight with a suitable developer It is recommended to carry out the process as follows

The plate is laid for two minutes in an actinal solution (i e four per cent potassium iodide) This can be done in a suitable cloth bag. After this the development may be carried out in subdued daylight using equal parts of the solutions A and B

A.

Water	600 grammes.
Anhydrous sodium sulphite	20 grammes
Metol	1 gramme.
Hydroquinone	8 grammes.
Potassium bromide	40 grammes.

B A three per cent caustic potash solution.

The plate should of course be rinsed before developing The latter operation takes about five minutes. The fixing is carried out as usual except that it takes a little longer The exposure should be ample The potassium iodide solution may be used over and over, but the developer should be mixed fresh for every plate —Chemiker Zeitung

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Limitation of the Speed of Automobiles.

In England a recent municipal police ordinance requires high power automobiles to carry apparatus which will give warning when the city speed limit is exceeded or will automatically diminish the speed in such cases. An apparatus of the first class which is much used, consists of an air-compressing cylinder prolonged at the bottom by a smaller cylinder containing a piston which has two peripheral vents and is forced forward by a spring.

The piston of the air-compressing cylinder is connected with the driving mechanism, and its velocity is proportional to the speed of the vehicle So long as this speed is below the prescribed limit, the pressure of the air which continually escapes through one of the vents of the small piston remains too low to move this piston and compress the spring. When the legal speed limit is exceeded however, the pressure rises, and the small piston is forced back until the second vent comes opposite a whistling vent in the wall of the small cylinder, so that the whistle is sounded by the escaping air

An apparatus of the second class comprises an oil pump, the pipe of which is provided with a three-way cock This cock is controlled by a centrifugal regulator, and its third channel communicates with a cylinder containing a piston which controls the accelerator, the brake, and the transmission When the speed exceeds the normal limit, this third channel is opened by the action of the centrifugal regulator, and the oil is forced into the cylinder where, by its pressure on the piston which operates the brake, etc, it reduces the speed of the vehicle to the normal limit. This limit is indicated on a dial, and it can be varied by adjusting the spring of the centrifugal regulator by means of a key

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The Current Supplement.

In the industrial development which the last one hundred years has witnessed it may well be claimed that the industry of iron and steel stands among the foremost Mr F W Harbord in an interesting article in the current SUPPLEMENT, No 1764, considers the various causes which have assisted in these vast developments how on the one hand the engineer and chemist have made this progress possible, and how on the other hand the metallurgist, responding to the call of the varied modern requirements, has supplied the materials without which modern engineering developments would have been impossible Dr Alfred Gradenwitz tells how standard clocks are operated by wireless in the city of Vienna. The exhaustive review of recent improvements in the internal-combustion engine which has formed a feature of the last two numbers of the SUPPLEMENT is concluded Mr Fred W Lane shows how a practical telephone may be employed C. van Langendonck writes on the wonderful armored concrete viaduct of the Rotterdam and Scheveningen line. "The Seven Styles of Crystal Architecture" is the title of a paper which was read by Dr A. E. H Tutton before the Winnipeg meeting of the British Association for the Advancement of Science That paper is published in the current SUPPLEMENT Emile Gadeceau contributes a popular article on marine plankton Under the title "The Red God of the Sky," a popular article on Mars and theories of Martian habitability is presented

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Himly gunpowder contains 45 per cent chlorate of potash, 35 per cent of saltpeter, and 20 per cent of coal tar In making it up the tar is dissolved in benzine, the solution mixed with the salts and the benzine then evaporated.

SATURN AND HIS RINGS.

BY PROF. FREDERICK R. HONEY, TRINITY COLLEGE.

The study of Saturn and his rings is one of the most fascinating in astronomy. The enormous bulk of the planet (second only to Jupiter in diameter); its low density (less than that of any other planet), the great difference between the polar and equatorial diameter, and the rapidity of its axial rotation, alone make Saturn an object of peculiar interest. But the conspicuous features of the Saturnian system, viz., the vast rings and the brilliant retinue of ten satellites, which distinguish the planet from the other members of the solar system, constitute the problems of chief interest in the study mentioned.

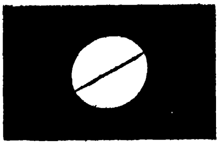

Fig 1 —SATURN'S RINGS IN 1907

Among the many advances in astronomical discovery is included a more accurate knowledge of Saturn's rings, the plane of which coincides with that of the planet's equator It has been clearly proved that the theory of a rigid ring is untenable, and this view has long since yielded to the more scientific conclusion which maintains that the rings are in a mobile state, and that they are probably composed of swarms of meteors or satellites too small to be distinguished in the telescope. These bodies, obedient to the laws which govern the motions of satellites around their primary, would arrange themselves in the order as it now exists. The complexity of the problem is apparent. Since the thickness of the rings is not more than a hundred miles, and the diameter of the outer ring about one hundred and seventy thousand miles, the dimensions of these bodies must be very small, and their number extending over such a vast area well nigh incalculable. The installation at the present time of larger reflectors in our observatories augurs well for the value of observational work, and it is to be expected that in the future a more accurate knowledge of the constitution of the rings of Saturn will be obtained.

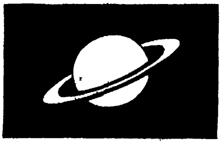

Fig 2 —SATURN'S RINGS IN 1909.

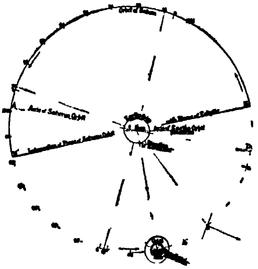

Fig. 3.—RELATIVE POSITIONS OF SATURN AND THE EARTH.

Saturn is now in that quarter of his orbit which includes perihelion. At an opposition which is near perihelion the planet approaches nearly one hundred million miles nearer the earth than at an aphelion opposition. As a consequence the apparent diameter of the planet and of the rings will increase at each opposition until perihelion is reached.

The plane of Saturn's orbit is inclined at an angle of nearly 2½ degrees to the plane of the ecliptic. In the diagram the full line represents that part of the orbit which is above the ecliptic; the dotted line the part below. The intersection of the plane of the orbit with that of the ecliptic is N N', and these points are respectively the ascending and descending nodes. A P is the axis of the orbit whose center c is nearly fifty million miles from the sun. The revolution of the planet at a mean distance of 886 million miles from the sun is accomplished in nearly 29½ years; oppositions occurring at average intervals of 378 days. The positions of Saturn at successive oppositions are shown from 1891 to 1911. The plane of the rings is inclined at an angle of 28 degrees to that of the ecliptic, and the plane traverses the earth's orbit twice during each revolution in opposite directions in a little less than a year (= 360 days) When it passes through the sun it is pierced by the planet's orbit at a and d, the positions of Saturn at opposite points in the orbit, which are reached at intervals of about fifteen years. When the planet is at either of these positions an edge view of the rings is presented to the sun. The extreme points of contact of the plane of the rings with the orbit are b and e, and when Saturn is at either of these positions the rings are seen to the best advantage, i. e., they open to their greatest apparent width. The minor axis of the ellipse representing each ring is nearly one-half the length of the major axis.

At the date of the opposition of 1899 the planet was near b, and a satisfactory view of the northern hemisphere of Saturn and of the upper surfaces of the rings was obtained At the opposition near e the southern hemisphere and the under or southern surfaces of the rings will be visible. Also the planet will be nearer the earth, and the apparent dimensions increased about one-eighth. Saturn will be in the northern heavens and therefore seen to good advantage in high latitudes The plane of the rings traversed the earth's orbit in 1891 2 Fifteen years later, in 1907, this plane again crossed the earth's orbit, and an edge view was obtained. Fig. 1 shows Saturn and his rings in this position, making apparent the difference between the polar and equatorial diameters The thickness of the rings is estimated between fifty and one hundred miles. But this measurement is so small in comparison with the diameter of the ring that it is impossible to represent it in correct proportion by the scale of the figure The fine white line may therefore be accepted as a representation of the rings for a short period of time just before and after the edge view was presented, when they entirely disappeared, and the planet alone remained visible. The positions of Saturn and the earth are shown at the date of opposition in 1909 It is scarcely necessary to say that while the planets are correctly proportioned in the plot, their dimensions are enormously exaggerated in order to compare their magnitudes. If they were drawn to the scale of the orbits they would shrink to mere points. Saturn's axis moves parallel to itself. To an observer on Saturn (if life were possible on the planet) the heavens would appear to move in the same general direction as they appear to us, but around another pole, and in less than half the time, as Saturn's rotation on his axis is accomplished in about ten hours and a quarter

Two years have passed since the edge view was presented to the earth. The rings are gradually widening, and their under surface becoming visible. Fig. 2 shows saturn and his rings as seen in a telescope at the date of opposition this year As the telescope gives an inverted image, in order to obtain a correct view Fig. 2 should be inverted. The larger area of the planet in the drawing represents the southern hemisphere which is turned toward the earth. The figure shows the division between the outer and inner rings, and between the "crape" ring and the planet. At each successive opposition the rings will widen and the markings on their southern surfaces will be more easily distinguished.

The present time offers an excellent opportunity for a telescopic study of Saturn and Mars. Both planets are evening stars, and both are near opposition. They are slowly approaching each other and will be in conjunction on December 31st.

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Various salts added in small quantities to the water used in mixing Portland cement appreciably accelerate or retard the setting of the mixture. The setting is retarded by water containing 4 per cent or more of sodium chloride, and by weak solutions of calcium chloride, but the latter salt in concentration higher than 9 per cent acts as an accelerator. Aluminium chloride accelerates, while iron chloride, most soluble sulphates, and even plaster of Paris retard setting. Aluminium sulphate is an accelerator, and in the compound alums its effect preponderates over that of the retarding alkaline sulphates and produces a slight acceleration. The alkaline carbonates accelerate in weak solutions, but soda acts as a retarder when its concentration exceeds 10 per cent. [illegible] phosphates, chromates, and [illegible] centration retard the setting.

Correspondence.

AN ODD PADDLE-WHEEL BOAT.

To the Editor of the SCIENTIFIC AMERICAN

Among the odd boats in your recent issues, I failed to note a duplicate of one I saw in Canadian waters. It was a small excursion boat, sidewheeler, propelled by power furnished by a team of horses working on a treadmill. The speed was not great, but the boat surely moved, and furnished amusement for a goodly party which it happened to have the day I saw it. A band was playing and people shouting as we sped by on a steamer.

J DOUX.

Utica, N. Y.

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THE HEIGHT OF MOUNT RAINIER.

To the Editor of the SCIENTIFIC AMERICAN

Reading to-day in a recent issue of the SCIENTIFIC AMERICAN, I saw this statement in reference to Mount Whitney "This peak is the highest in the United States." Height given, 14,501 feet.

I was with Prof. McClure in 1897 when he ascended Mount Rainier, and helped him to carry instruments for use in determining the height Although he was killed in the descent, his notes were complete, and the subsequent calculations made from them by his friends gave the height as 14,528 feet above sea level. I believe these figures have been accepted as the true height.

HARVEY F. MITCHELL.

New York city

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THE SCIENTIFIC AMERICAN AT JERICHO.

To the Editor of the SCIENTIFIC AMERICAN

I inclose you a portion of your issue of February 7th, 1885, which was given me by a friend of mine, Dr Herman Bryan, a returning medical missionary from the island of Hainan. Dr Bryan took a trip through the Holy Land, and found in the reading room of Cook's Hotel at Jericho, on April 10th of last year, a copy of this issue, which was the sole American reading matter provided by the hotel management. Dr Bryan has returned to China now, but he asked me to mention this to you, and suggest that the SCIENTIFIC AMERICAN might well be represented by a more recent copy

ALEX L. PUGH.

New York city

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WHY NOT A MONUMENT TO FITCH?

To the Editor of the SCIENTIFIC AMERICAN

It gave all members of my family great pleasure to read the SCIENTIFIC AMERICAN editorial of October 9th. It strikes the keynote of the situation in regard to our unequal distribution of acknowledgment to steamboat inventors. My father (James Arthur) pronounces it the best column that has appeared to date.

We of course all realise that it is impossible to do honor to all the early inventors, but we should at least do justice to the United States of America by placing its steamboat successes in the right century We have just been celebrating the fact that the United States had a steamboat in the nineteenth century while as a matter of fact we had several successful ones in the eighteenth century, and the one referred to in your editorial attained a speed which was not exceeded until the following century was several years old.

We all hope that your timely remarks will bear fruit and that a bronze tablet will be placed near Collect Pond, and that the grave of John Fitch may at least be properly marked.

DANIEL ARTHUR.

New York, N Y

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"INFLEXIBLE" AND "CONNECTICUT" COMPARED.

To the Editor of the SCIENTIFIC AMERICAN

Pardon me for the presumption of criticising anything in your very valuable paper, but an article in the issue of October 9th, dealing with the visiting warships anchored in the Hudson River, I think is misleading in one particular In comparing the broadside fire of the three battleships representing France, England, and the United States, the statement is made that the "Inflexible" has eight 12-inch guns which can be fired on one broadside. But, if I am not mistaken, the "Inflexible," like all her sister "Dreadnoughts" of the English navy, is unable to fire all her 12-inch guns on both broadsides, on account of the position of the two wing turrets. If this is true, then the "Inflexible's" superiority would be mainly in her great speed I believe that the "Connecticut," with her rapid-fire 8-inch and 7-inch guns, coupled with her four 12-inch guns, would more than hold her own with an "Inflexible." Although the 8-inch and 7-inch guns, theoretically, will not penetrate the "Inflexible's" amidship armor belt, still the rain of shells from these lighter guns would play havoc with every part of the vessel above the low 7-inch armor belt of the English cruiser This would not affect the crews in the 12-inch turrets, but when the ship is riddled fore and aft, with all the upper works, [illegible] all the [illegible] [illegible] and quickly overcome the "Connecticut," by the mere concentration of her 12-inch guns. Now, I think it would be extremely unhealthy for the "Inflexible" at this range, as the terrible broadside of the "Connecticut's four 12-inch, four 8-inch, and six 7 inch guns would completely overwhelm the six 12-inch of the former Even admitting that the 7 inch guns of the "Connecticut" are protected with comparatively light armor, still the tremendous rate of fire of that battery in addition to the four 8-inch and four 12-inch, would so blind the gunners on the enemy that they would be unable to properly handle their guns. Even up to 9,000 yards, the 8-inch and 7 inch guns would be very effective in carrying away the upper works of an enemy, thus destroying his ability to handle his ship. So I would like to see our "Connecticut" placed in a more favorable light in a comparison with the "Inflexible."

EMERSON B MANLEY

U S S "Kansas."   Machinist's Mate

[We mentioned in the article referred to that the secondary battery of the "Connecticut" would riddle the unprotected parts of the "Inflexible." The mid ship pairs of 12-inch guns *on this ship are placed diagonally*, and therefore all four guns can be fired on either broadside, through a limited angle.—ED]

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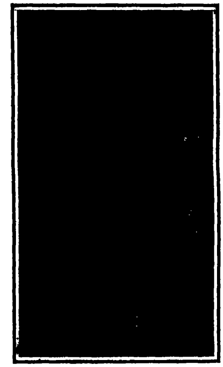
RESULT OF A LIGHTNING STROKE.

To the Editor of the SCIENTIFIC AMERICAN

The accompanying photograph was taken recently at Velva, N D. Three young men were putting up hay, when a thunderstorm came up, and all three were knocked down, the lightning killing a team of horses, and rendering the two men who were holding them unconscious for some hours. The third man saw the others fall, and then lost consciousness himself His team, standing a couple of rods away from the other was knocked down, and a hole was torn in his cheek whether from the fall or from the lightning it might be impossible to say He came to, mounted a horse, after pulling one of his companions from under one of the dead animals, and rode for help Securing that, he returned, and then fainted, partly from loss of blood, and remained unconscious several hours. The other two men regained consciousness that night, and all three were practically over the effects of the stroke within a week after the occurrence The photo shows a new pair of shoes worn by one of the men, and a new, heavy pair of overalls, just as they were taken from him after the accident



RESULT OF A LIGHTNING STROKE.

HUGH J HUGHES.

Agricultural College, N D

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THE NUMBER OF OUR ANCESTORS.

To the Editor of the SCIENTIFIC AMERICAN

If you and your readers are not tired of this question, may I suggest another solution than that Mr Solon De Leon gives? I may perhaps point out that, originally, I simply stated the problem, did not say it vexed me, and made no false sociologic assumption

Let X represent the first generation, and so assume $X=2$ Assume continuity of descent, and let X^y represent some later generation We need not trouble about what value we give to y, all we want is that the number of individuals of the generation is represented by X^y We get, say, 20,000 000 of individuals descended from 2 original individuals, and see at once that there is some consanguineous relationship between all the individuals of the X^y generation. So, if we assume all of us now existing are descended from some original man and woman, it is clear we are all of us *consanguineously* related

Now consider any one individual existing at the present time Then his parents *are* consanguineously related, but in most cases the blood relationship is so remote that he will treat the relationship as *non-existent* We have, in the simple form of the problem I use a series, X X^1, X^2 X^y, where each individual of the X^y generation relates back in consanguinity to the original generation X but there being so many intermediate generations, his *collateral* consanguinity to any other individual of his generation is so remote that to him it is non-existent For an example of this we have the fact that man as an organism is related to the monkey as an organism through some arboreal ancestors But the *collateral* consanguinity is so remote, that we treat it as non-existent.

F C CONSTABLE.

Wick Court near Bristol England

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THE HIGHEST HUMAN ASCENT

To the Editor of the SCIENTIFIC AMERICAN

On page 239 of your issue of October 2nd 1909, you state "The record of altitude in aeronautics has been attained by Sig Piacenza and Lieut Mina in an ascension made from Milan on August 10th 1909 Their great spherical balloon reached an elevation of 38,700 feet, or more than seven miles." This statement, based probably on the press reports, is incorrect, as proved by a letter from the aeronauts themselves, Messrs Mina and Piacenza, published in the French journal L'Aérophile of September 1st, from which it appears that the maximum height was only about 9,200 meters or 30 180 feet. Since their cotton balloon held only 80 500 cubic feet and contained illuminating gas, this was a remarkable performance, and though there is some doubt as to the barometric observations, it probably exceeds both the French and Italian records. The world's record is however still held by Messrs. Berson and Süring who ascended from Charlottenburg, near Berlin, on July 31st, 1901, in a balloon of nearly 300 000 cubic feet capacity partially filled with hydrogen gas, to the height of 34 450 feet.

A. LAWRENCE ROTCH

Blue Hill Observatory, Hyde Park Mass

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AERIAL WARFARE IN 1798

To the Editor of the SCIENTIFIC AMERICAN

In connection with the letter published in your issue of September 18th it may be of interest to cite an earlier suggestion of invading England by balloon In R. P Hearne's Aerial Warfare a copy of a print of 1798 is reproduced from the collection of Capt. Baden Powell, and this print bears the following inscription

The Grand Republican balloon intended to convey the Army of England from the Gallic shore, for the purpose of exchanging French liberty for English happiness! Accurately copied from a plan presented *to the executive directory by Citizen Monge'*

The Grand Republican balloon is depicted as having a spherical gas bag to which is suspended, by means of rope ladders a peculiar contrivance half ship and half house On top of the gas bag is the Gallic cock holding a tri-color surmounted by a liberty cap Half way down the sphere is a great circle on which is encamped a detachment of troops and a guillotine. Pipes to let out the inflammable air also appear while a pair of ornamental wings are noted A small captive balloon to serve as a boat is fastened to the great circle from which a lighthouse juts out.

The lower portion is a jumble of houses and sails with apartments for the officers in the hold Below this again is the magazine suspended by cables while a box like structure on one side bears the designation of water closet." The print bears the mark of a London publisher and forms an interesting addition to the cartoons of that period

GERALD ELLIS CRONIN

The operation of the 1,200-volt direct-current system of interurban railway control is dealt with by Mr C D Eveleth in a paper read before the Street Railway Association of the State of New York Four lines have adopted the system in America The obvious advantages assuming that there are no drawbacks which Mr Eveleth sets out to demonstrate are that the first cost is low maintenance is not more expensive and extensions to existing lines can be entered upon with much more ease and confidence. There are now in operation or under contract eleven systems of 1 200-volt direct-current railways, employing motors of 50 75 and 150 horse-power, and Mr Eveleth predicts that in a few years the 1,200 voltage will be as common as 600 The cars can be easily operated on 600 volt sections where necessary Those electrical engineers in Great Britain who still hope that the authorities will some day 'encourage" *the construction of rural* and interurban light railways will welcome these American experiences as suggesting further sources of economy in rendering their schemes commercially attractive

THE LATEST SUBMARINES OF THE UNITED STATES NAVY

As in all mechanical development an improved type of any particular device is an evolution from its predecessors so in general the modern Holland torpedo boat of which the government is now building m[illegible] is a lineal descendant of the original Holland boat of that name which first made its appearance at the close of the Spanish war

The dark object in the center is the conning tower. The periscope to which the flagstaff is attached projects above water when the boat is submerged and by its means the commanding officer can view surrounding objects as clearly as though he looked through a field glass at the surface

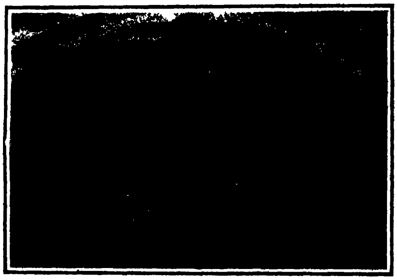
Submarine beginning to dive

These engines are used only in traveling at the surface. They can drive the boat at 14 knots. For submerged work they are uncoupled and the boat is driven by two electric motors. The latter take their energy from storage batteries which have been charged by the gas engines.

One of the twin internal-combustion engines of the submarine.

To right and left are the electric motors which drive the boat, when submerged, at 10.5 knots per hour

Looking aft in engine room



In the center are the two torpedo discharge tubes. To the left is the electric motor and gear by which the doors in the nose of the submarine are opened for discharge of torpedoes.

View on main floor looking forward

The hand wheel to the right operates the diving rudders used for steering in a vertical plane. In front of the wheel is a gage whose pointer shows the depth in feet of the boat below the surface. The curved dark line below pointer is a spirit level which shows the inclination of the boat.

Diving wheel and depth pressure gage

This shows the roof, not the floor, of the submarine interior. The horizontal eyepiece and the vertical telescope tube are rotated by means of the hand-wheel whose pinion engages an internal gear ring

Eyepiece at bottom of periscope

THE LATEST SUBMARINES OF THE UNITED STATES NAVY

The form of hull is generally described as cigar shaped It is built of the very best quality of mild steel and the workmanship is of the highest order for the reason that every seam and rivet must be perfectly tight in view of the service which the boat is called upon to perform Not only do vessels of this type undergo all the stresses of sea and weather which other vessels are subjected to but in addition they are required to navigate at considerable depths below the surface of the water At these depths the pressure of the water is great so that the hull must be made sufficiently strong to withstand it

Up to the present it has been found that the most efficient size for a boat is about 140 feet long and 14 feet in diameter With such dimensions a boat can be built which will fulfill all requirements which the naval authorities of the world demand from it That is to say it can cruise on the surface for long distances at a speed of fourteen knots At lower speeds its radius of action extends to several thousand miles For submerged work large storage batteries are provided which furnish energy sufficient to drive the boat from ten to eleven knots for a period of over an hour The same electrical energy will drive her at a lower speed for a much longer time The latest submarines built for the government by the Fore River Company at about five knots speed can run completely submerged with nothing visible above water, for a distance of 150 miles.

There are two distinct conditions in which the boat may be used In the first, commonly known as the surface condition, the boat is prepared for cruising. A considerable portion of her hull is above water a removable navigating bridge is in place and she is driven by large powerful internal-combustion engines Under these conditions she is managed in about the same way as any vessel built to run upon the surface. As for sea-going qualities our submarines have been found in practice to be excellent In ordinary weather they are fully as comfortable as any surface craft of the same dimensions and even in the heaviest weather they are entirely seaworthy

The second distinct condition exists when the boat is submerged. To pass from the surface to the [illegible]

(Continued on page [illegible])

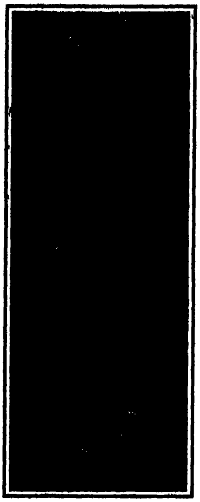
AN ALL-SEEING EYE FOR THE SUBMARINE.

Vision under water is limited to but a few yards at best, and hence a submarine boat when submerged would be as blind as a ship in a dense fog and would have to grope its way along guided only by chart and compass, were it not for a device known as a periscope, that reaches upward and projects out of the water enabling the steersman to view his surroundings from the surface. Of course the height of the periscope limits the depth at which the craft may be safely sailed. Nor can the periscope tube be extended indefinitely because the submarine must be capable of diving under a vessel when occasion demands But when operating just under the surface where it can see without being seen the craft is in far greater danger of collision than vessels on the surface because it must depend upon its own alertness and agility to keep out of the way of other boats. The latter can hardly be expected to notice the inconspicuous periscope tube projecting from the water in time to turn their great bulks out of the danger course

The foregoing article describes the type of periscope now in common use on submarines and one of the engravings on this page clearly illustrates the principles of the instrument A serious defect of this type of instrument is that the field of vision is too limited The man at the wheel is able to see under normal conditions only that which lies immediately before the boat It is true that he can turn the periscope about so as to look in other directions but this of course involves considerable inconvenience On at least two occasions has a submarine boat been run down by a vessel coming up behind it

As long as the submarine has but a single eye it would seem quite essential to make this eye all-seeing and, since the two lamentable accidents just referred to an inventor in England has devised a periscope which provides a view in all directions at the same time This has been attempted before but it has been found very difficult to obtain an annular lens mirror which would project the image down the periscope tube without distortion The accompanying illustrations show how this difficulty has now been overcome While we will not attempt to enter into a mathematical explanation of the precise form of the mirror lens it will suffice to state that it is an annular prism The prism is a zonal section of a sphere with a conoidal central opening and a slightly concave base All the surfaces however are generated by arcs of circles owing to the mechanical inconvenience of producing truly hyperboloidal surfaces. The lens mirror is shown in section at A in Fig. 1 The arrows indicate roughly the course of the rays into the lens and their deflection from the surface B, which is spherically ground. The tube is provided with two objectives C and D (Fig 3) between which a condenser E is interposed at the image plane of the lens C At the bottom of the periscope tube the rays are reflected by means of a prism F into the eyepiece Two eyepieces are employed One of low power G is a Kelner eyepiece the purpose of which is to permit inspection of the whole image while a high powered eccentrically placed Huyghenian eyepiece H enables one to inspect portions of the image The two eyepieces are mounted in a rectilinear chamber I which may be rotated about the prism at the end of the periscope thus bringing one or other of the eyepieces into active position The plan view Fig 4 shows in full lines the high powered eyepiece in operative position while the dotted lines indicate the parts moved about to bring the low powered eyepiece into use A small catch J shown in Fig 2 serves to hold the chamber in either of these two positions The high powered eyepiece is mounted on a plate K which may be rotated to bring the eyepiece into position for inspecting any desired portions of the annular image The parts are so arranged that when the eyepiece is in its uppermost position as indicated by full lines in Fig 2 the observer can see that which is directly in front of the submarine and when the eyepiece is in its low position as indicated by dotted lines he sees objects to the rear of the submarine. With the eyepiece at the right or at the left he sees objects at the right or left respectively of the submarine The high powered eyepiece is slightly inclined so that the image may be viewed normally and to equal advantage in all parts Mounted above a plain unsilvered portion of the mirror is a scale of degrees which appears just outside of the annular image A scale is also engraved on the plate K with a fixed pointer on the chamber making it possible to locate the position of any object and rotate the plate K so as to bring the eyepiece H on it The scale also makes it possible to locate the object with respect to the boat

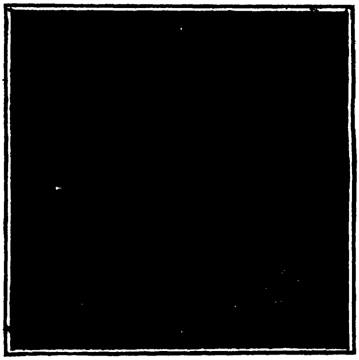
This improved periscope is applicable not only to submarine boats but for other purposes as well such as photographic land surface work in which the entire surroundings may be recorded in a single photograph The accompanying photograph taken through a periscope of this type shows the advantages of this arrangement and gives an idea of its value to the submarine observer when using the low powered eyepiece Of course by using the other eyepiece any particular part of the view may be enlarged and examined in detail



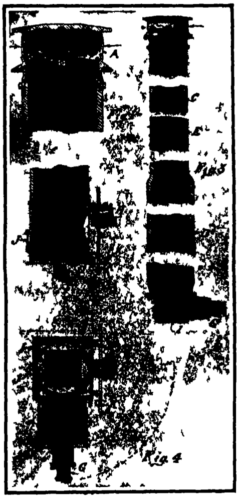
Periscope in general use.

The universal observation lens.

The periscope top.



A photograph taken with the periscopic universal lens.



British periscope with universal eye.

FORMS OF PERISCOPES FOR SUBMARINES THE EYE THAT LOOKS IN ALL DIRECTIONS AT ONCE

Cement for Meerschaum—Stir very fine meerschaum chips with white of egg or dissolve caseine in water glass, stir in finely powdered magnesia and use the cement at once. It hardens very quickly

Red and White Meat.

The flesh of cattle sheep horses wild hogs deer hares pigeons ducks geese and salmon is red or dark colored while the flesh of calves domestic hogs rabbits trout pike al flat fishes lobsters and crabs is white or pale In fowls white meat is found in the breast dark meat in the legs and thighs The contrast is most sharply marked in wild fowl In frogs on the contrary the legs are white and the rest of the flesh is dark The mackerel the eel and many other kinds of fish also have both white and dark flesh

Knobloch has shown that this anatomical distinction between white and dark muscles runs parallel with the distinction between agile and sluggish muscular fibers which has been established by physiological experiment In general pale muscles are more active than dark or red muscles They contract more quickly but they become fatigued sooner than the dark muscles because they produce in performing the same amount of work a larger quantity of lactic acid which is the fatigue product of muscles The two classes of muscular fibers differ also in sectional dimensions The adductor or shell-closing muscle of the mussel consists of a white and a gray portion which can be clearly distinguished from each other and the presence of both kinds of fibers is explained by the habits of this mollusk

The mussel propels itself through the water by quickly opening and closing its shell but in the presence of danger it keeps its shell closed for long periods The rapid swimming movements are started by the pale and agile muscular fibers and maintained by the automatic operation of the dark sluggish fibers which also serve to hold the shell closed The same biological law of division of labor appears to govern the character of the muscular structure of higher animals The relative proportions of pale agile fibers and dark sluggish fibers are determined by the method of locomotion The incessantly leaping frog possesses a much larger proportion of white muscle than the slowly creeping toad The leg muscles of fowls are dark because the legs almost continually support the weight of the body but the breast muscles are white because the wings are used only occasionally and for short periods The dove continually on the wing has dark-colored breast muscles The flesh of the sportive calf and lamb is white while that of the contemplative cow and sheep is red The ever active heart and respiratory muscles and the very frequently used muscles which move the eyes and jaws are red The flesh of calves and lambs and the white legs of young chickens darken with advancing age Knobloch infers that the white muscles represent the primitive stage through which every dark muscle has passed.—Prometheus

COL JOHN JACOB ASTOR'S NOVEL STEAMSHIP CHAIR

Many people in crossing the ocean have experienced inconvenience by reason of the fact that the chairs in the saloon and card rooms are rigidly screwed to the floor The chairs are secured at such a distance from the tables that they will accommodate persons of very ample proportions and therefore when a comparatively thin person occupies a chair he finds it necessary to sit merely on the edge for should he endeavor to lean back in the chair he finds himself too far from the table

While recently returning from Europe Col John Jacob Astor conceived of a very simple and practical scheme whereby the chairs may be firmly held in place at any desired distance from the tables or may be easily released and moved about Col Astor's scheme involves the use of a vacuum cup beneath the chair and so mounted that it may be pressed into engagement with the deck or floor to hold the chair by suction or the vacuum may be broken the cup lifted and the chair released

If the chair is on a deck or hardwood floor or on rubber tiling the vacuum will hold indefinitely while if used on a carpet it will probably be necessary to depress the cup and raise it again occasionally to form a new vacuum This device will undoubtedly add greatly to the comfort of the traveling public as chairs may then be quickly and securely fastened at the desired distance from the table to accommodate either fleshy or thin persons Col Astor intends to present this invention to the public as has been his custom with all his recent inventions

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Gold Dredging in Alaska.

BY [illegible] WALSH

The continued exploitation of new gold fields by the big gold dredges in different parts of the world has given to this industry many new points of economy which the companies are taking advantage of The great districts where the gold dredges have been in most successful operation are Australia California and Alaska In both of the former places the wholesale dredging of the ground by the mammoth gold ships has caused some trouble with the official authorities and the question of restoring the dredged fields to something like their former condition has been adjudicated in the courts

In Australia the work of reclaiming the dredged ground has been accomplished by advance stripping of the surface soil so that this can be separated from the coarse sand and silt from below The surface soil is first stripped and deposited in separate places before the gravel is touched and then after the dredging is completed the surface soil is replaced so that the land can be used for other purposes In California where the gold ships threatened to interfere with the flow of the rivers the dredging companies have been compelled by the State authorities to restore the dredged land in certain districts so that the normal water flow will not be interrupted

No such trouble however is found in Alaska where gold dredging has been carried on extensively in the past year or two Alaska is more suited to this form of gold mining than any other country and great stretches of river soil await the companies with dredges When the first big gold dredge was shipped to Alaska in sections and then assembled there it was looked upon as a very uncertain investment Owing to the short open season when the dredges could be operated and the great cost of getting the dredges into the distant mining regions it was not looked upon with favor by capitalists

Subsequent events and experience have changed all of this In the first place the enormous area of gold land suitable for bucket dredging makes it possible for the gold ships to operate indefinitely without being transported to new regions In fact the field is almost inexhaustible Consequently the investments in the big dredges cannot prove other than very profitable even if for the first year or two they could make little But even with the comparatively short open season when the ground is not frozen hard the gold ships have proved extremely profitable and the fleet up there has steadily increased from year to year

In California where the gold dredges can be operated the year around the dirt yields on an average only 15 cents per cubic yard and yet with this low yield the work is very profitable On the other hand the placer fields of Nome run from $1 to $20 per cubic yard which accounts for the fact that the dredges make more money in their short summer season than the California dredges can do in twelve months of the year A five foot bucket dredge can wash as much gravel as 3 000 men can do by hand and consequently it can secure a profit on dirt so low in grade that hand washing is utterly impossible

There are more than a dozen gold dredges now in operation in the Nome district, and every one of these is earning big profits The Guggenheims of New York have been operating three dredges for several years and several new ones are now in the course of construction The Nome Gold Dredge and Power Company composed chiefly of New York capitalists and engineers has installed several more dredges in the Nome district This concern owns or controls nearly 2 000 acres of placer ground which on a low estimate yields about $3 50 of gold per cubic yard

It costs about $120 000 to get one of these dredges up in Alaska and ready for operation in the placer district but such a dredge will yield a net return of nearly $600 000 per year Such enormous returns on the investment certainly justify the installation of new dredges. A dozen such dredges now in operation in Alaska yield annually several million dollars worth of gold and most of this is reclaimed from districts that the hand operating companies overlook. The craze for new districts that yield enormous returns continues to attract the average miner and he passes over unnoticed the placer mines that prove rich harvests to the dredge companies There is no interference by State authorities with dredging in Alaska and no thought or consideration of restoring the surface after operations enters into the calculations of the companies

The character of most of the gravel in the Nome district makes it ideal for either dredging or hydraulicking It is almost entirely free of large bowlders clay substances and roots which might obstruct the operations of the dredge or sluicing apparatus The placer lands lie for the most part in valleys between sloping hills This land is covered with snow early in the fall and thus prevents hard freezing As a result dredging operations can begin as early as the first half of June and continue fully four months or for about 120 days This makes a season's work and then the dredges have to stop operations for the long winter It seems like a very short season for mining operations but owing to the character of the soil and the gold yield it proves very profitable

COL JOHN JACOB ASTOR'S IMPROVED STEAMSHIP CHAIR.

Before an investment is made in a gold dredge of this character the placer land is first carefully investigated and the probable gold output estimated Thus before the first dredge was shipped to Alaska upward of a hundred shafts were sunk to depths ranging from 10 to 15 feet and the lowest yields of gold were found to be $3 50 per cubic yard while in the river beds the gold often ran as high as 1[illegible] cents per pan or over $20 per cubic yard

Except at the foothills the dredge companies around Nome have never yet struck bedrock and the lowest shaft put down was 15 feet in depth Further sinking was prevented by the shafts filling with water but from every indication the bedrock is at least 25 to 30 feet below the surface This bedrock is composed of mica schist and slate. In all the dredging operations of these placer mines, the values increase more steadily at bedrock than at higher points and even from 6 to 18 inches into the bedrock the returns are large. The whole character of the land is ideal for dredging and there is plenty of water for as many dredges as could possibly be used

The fact is the coming of the big gold dredges in Alaska and their successful operation, with unlimited possibilities for work for many years to come has marked a new era in mining for the precious metal in this far northern country It is the beginning of the end of aimless unscientific gold mining The great finds of gold where prospectors can pick up gold in quantities are no longer so common as a few years ago The field has been pretty nearly investigated and the character of the mining must change to suit new conditions This means that the influx of fortune hunters will gradually cease, and mining will fall into the hands of companies who are willing to get their returns gradually through improved, though somewhat expensive methods of work A great many owners of ordinary placer claims are today renting out their land to gold-dredging companies and others are organising for the purpose of installing their own dredges Taking the returns for a period of five or ten years the profits of a gold dredge company are infinitely higher than another which depends entirely upon making rich finds and then gathering the surface gold for quick returns Gold dredging in Alaska is thus an infant but lusty industry and its growth in the next few years must be phenomenal and steady

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Has the Earth's Climate Changed in Historic Times?

The explorations in Central Asia have laid bare the ruins of once flourishing cities M Boutquin in the French journal Ciel et Terre proves by historical evidence and modern scientific discoveries, that the abandonment of these regions by the human race was brought about by causes entirely unrelated to such supposed meteorological changes as a general cooling of climates or a progressive desiccation of the globe In Europe, for example a sensitive lowering of the temperature and decrease in the precipitation of rain and snow would have caused a well marked and continuous recession of glaciers but no such recession is shown by the records of more than two thousand years. Heim has proved that although the glaciers of the Alps receded during the latter half of the nineteenth century they are now far more extensive than they were in the Middle Ages

Polybius in the second century B. C described the rich gold and silver mines of the Tyrol These mines yielded abundantly until the middle of the sixteenth century after which date their productiveness rapidly diminished because the mouths of shafts became covered with ice A shaft sunk at this epoch was covered in 1570 by a glacier 65 feet thick Resistance to the invasion of the ice soon became impossible In the eighteenth century the glacier was more than 300 feet high and in 1875 it had attained a height of 460 feet

For many years it was asserted that the east coast of Greenland had formerly enjoyed a mild climate which favored the growth of vegetation and gave rise to the name Greenland The historical researches of Rink and Von Maurer however have proved that the decay of the posts established by the Norwegians in olden times was caused by the introduction of a contagious disease and by the adoption by the Norwegian government of an unwise economic policy which provoked hostile attacks by the Eskimos Equally erroneous statements have been made in regard to Iceland

In the British Isles the cultivation of wheat formerly extended much farther north than it does at present simply because it was then in the absence of foreign competition, more profitable than it is now Yet it has been very difficult to gain acceptance for this elementary truth the popular belief in a change of season or climate for a long time prevailed over all evidence

In Belgium and other countries also agriculture has been radically transformed by the operation of economic laws improved methods of culture, and a more intelligent choice of crops. In the Middle Ages and until the fifteenth century the vine was cultivated in Bavaria and in other parts of Germany from which it has now almost entirely disappeared, but its disappearance is not due to climatic changes The wine produced in these districts was generally of inferior quality and with the growing refinement of taste it was gradually supplanted by foreign wines and good native beer

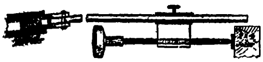
The culture of the vine has practically disappeared from Belgium for similar reasons Two Belgian abbeys still possess vineyards and make wine for sacramental use In France it has been proved that the vintage season has not shifted appreciably since the fourteenth century It has likewise been demonstrated that contrary to the popular belief the vine was never cultivated in Switzerland [illegible] very small extent in gardens and [illegible] in Swiss [illegible]

Handy Man's Workshop

AN EASILY CONSTRUCTED EQUATORIAL MOUNT FOR SMALL TELESCOPES.

BY PROF. R. W. WOOD, JOHNS HOPKINS UNIVERSITY, BALTIMORE.

In the course of some experiments which I have been making at my summer laboratory in East Hampton, Long Island, on the photography of the moon in ultra-violet light (= 3,100 — 3,200) it became necessary to provide an equatorial stand with a slow motion screw for accurate following. As a polar axis is often desired in a hurry for special work, and as there are doubtless many amateurs who sometimes feel the need of such a stand, it seems worth while to give a short description of a very efficient, though hurriedly improvised, one which I constructed for my purpose.



THE SLOW-MOTION SCREW.

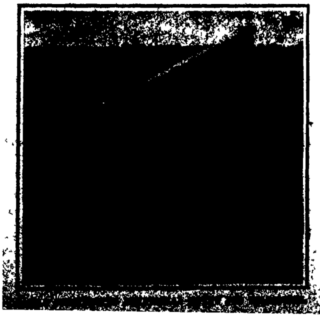
It was made from the frame of a discarded bicycle, the bearings of the steering rod being, however, in good condition, with little or no lateral movement. The wheels, sprockets, saddle etc., were removed and the frame stood up in a wooden box, in such a position that the steering axis was approximately at the latitude angle. The box was then filled with Portland cement (1 part cement with 3 parts of clean sand and sufficient water) which was allowed to solidify The larger places were filled with bricks and rock fragments to economise the cement A day or two is sufficient for the solidification, after which the box can be knocked to pieces, leaving the frame rigidly mounted in a solid and very massive block. This block was placed on a small brick pier and the adjustment of the polar axis made by blocking up one end of the cement base. A short piece of 2 x 4 inch joist was lashed to the handles of the bicycle with strong wire, which served as a support for the declination axis. The rest of the stand is to be designed according to the use to which it is to be put. In my own case I required merely a device which would enable me to keep my quartz telescope pointed accurately at the moon for two minutes From odds and ends which had accumulated in my shop the arrangement shown in the illustration was built A short plank was mounted on the 2 x 4 on a horizontal steel axis turning in brass bearings. To the forward end of the plank a rod was fastened which passed through a wooden block clamped between the lower ends of the front forks with a small bolt This block could be turned to suit the elevation of the telescope, and the rod fastened with a "set-screw," shown by an arrow in the picture

Slow motion about the polar axis was accomplished by a brass rod, hinged to a larger piece of rod which fitted into the T tube which formerly carried the saddle. A small piece of brass tubing was soldered to a small piece of ¼ inch sheet brass, through which passed the slow-motion screw, sharpened to a point and turned by a small wooden wheel, made from a spool (indicated by an arrow) The brass tube and screw could be clamped at any point on the long brass rod by means of a set-screw The point of the slow-motion screw turned in a small conical pit in a piece of brass fastened to the end of the 2 x 4 joist. The weight of the instrument being carried on the handles, that is, above the polar axis, the instrument always tended to turn (by gravity) upside down, except when pointed at the meridian This it was prevented from doing by the pressure of the point of the slow-motion screw, and by turning the screw either forward or backward according to whether the instrument was pointing east or west of the meridian, a very uniform rotation about the polar axis was secured. A diagram of the slow-motion screw is given in the accompanying line drawing.

The instrument was set approximately in the meridian by sighting the pole star in line with the edges of the two front tubes of the diamond frame The proper elevation of the polar axis was secured by trial, observing whether, in following the moon it moved up or down in the field of the telescope In half an hour I got the thing in such shape that I could keep the center of a small crater on the point of intersection of the cross hairs of the telescope for ten minutes, and as this was more than the required accuracy I let it go at that. The instrument as constructed works admirably except when pointed at the meridian. On passing the meridian the slow motion screw is carried over to the other end of the 2 x 4 joist, this movement being allowed by the hinge at the end of the rod When accurate following is not necessary, that is, when it is merely necessary to keep the object in the field, a more convenient arrangement would be a brass cog wheel attached to the steering rod below the handles, and turned by a worm wheel this would obviate the trouble when crossing the meridian It would not, however, give such uniform motion as the arrangement described, unless accurately and carefully made

For mounting a small telescope any device can be used which will permit the instrument to swing up and down in a plane.

It is quite remarkable how well the old bicycle frame lent itself to the construction of the stand The front forks which hold the "elevation" fixed and the saddle tube for supporting the slow motion rod could hardly be improved upon if made for the purpose



ALTERNATING CURRENT EXPERIMENTS.

BY FREDERICK E WARD

Students and amateurs who like to make electrical experiments are particularly fortunate if they have alternating current lighting service in their homes as the alternating current lends itself especially well to the performance of easy experiments that are at the same time both amusing and instructive Of the many kinds of experiments that may be made with simple apparatus there are perhaps no others that are more interesting than those which illustrate the principles of the rotary magnetic field and its application to electric energy meters and to induction motors.

For making the necessary apparatus there are required two similar laminated iron rings about 3½ inches inside diameter, 4½ inches outside diameter and ¾ inch thick. These may be built up by coiling up a sufficient length of thin sheet iron strips cut ¾ inch wide, using a round wooden block to start on Compact iron wire bundles of about the same dimensions may be substituted with good results or better than either of the above, rings made up of a sufficient number of thin sheet iron punchings. After the rings are made, all sharp edges should be rounded off with a file and a smooth covering of cotton tape be applied as shown in Fig 1, *A*.

If there is any choice between the two rings, select for the field the one that comes nearest to being a true circle on the inside For the winding on this ring use No 23 or No. 24 double cotton-covered magnet wire. Have the wire on a spool small enough to pass through the ring easily and begin at any point such as *B*, Fig 1 Wind the wire in a single layer with turns as smooth and close as possible on the inner circumference, until exactly one-quarter of the latter has been covered. Next reverse the direction of winding as shown at *C* Fig 1 and cover the second quarter of the ring by passing the spool through in the opposite direction, after tying down the little loop at *C* with a piece of thread. Make similar reversals at the half and three-quarter points, and cut off the wire near the place of beginning This completes one-half of the winding The second half is to be wound on top of the first half, and is to be similar in all respects except that the place of beginning must be shifted to a point 45 deg. away, as at *D* Fig. 1.

The second ring, which is for a reactance, is to be wound with 600 turns of magnet wire of any size larger than No. 20. This winding must not have any reversals in it, all of the turns being passed through the ring in the same direction.

Lay the two rings down flat on a piece of board and make connections to a 110-volt 60-cycle supply circuit as shown in the diagram in Fig. 1, where *S* indicates a snap switch or knife switch, and *L*, *L*, *L*, *L* four 16-candle-power 110-volt lamps. When the switch is closed current flows through the two windings on the field ring in such manner as to produce four magnetic poles that are not stationary but rotate or progress around the ring 1 800 times per minute A pocket compass placed close to one side in the field as shown will rotate at this speed and illustrate the principle of the synchronous motor in which the magnetized rotor is dragged around by the rotating magnetic poles of the field just as positively as if it were geared directly to the dynamo If the compass be placed close to the ring on the outside, it will turn in the opposite direction The field can be reversed by exchanging the connections to either one of its two coils

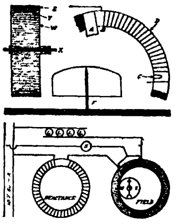


Fig 1.—DETAILS OF THE EXPERIMENTAL APPARATUS

To show the poles made by the field lay a sheet of white paper on the ring and sprinkle some fine iron filings on it while the current is on It is not so easy to show the movement of the poles in this way but it may be done as follows Shake some very fine iron filings through a piece of cloth on a sheet of paper and then hold up the latter by one corner The larger particles will slide off and only the very finest will cling fast like dust Lay the paper on the ring while the current is off and close the switch for the briefest possible moment Do this several times in succession and considerable movement of the particles will be observed

Drive a large pin through a piece of wood as shown in Fig 1 *F*, and balance on the point a brass box cover or bell so that the latter is free to turn If the magnetic field be then placed around the bell the latter will be slowly dragged around by reason of the eddy currents set up therein and will illustrate in part the principle of the driving mechanism of some forms of integrating wattmeters Observe how the speed of the piece of brass varies in proportion to the number of lamps that are lighted at *L*

If an iron (tin) box cover be substituted for the brass one the speed will be higher and the pull more vigorous, illustrating the principle of the induction motor If an empty tin can be thus supported in the field, it will be rotated with considerable force and soon get off the pin Fig 2 shows how the field may be supported in a vertical position and provided with a better rotor from which it is possible to get enough power to drive light toys The details of the rotor are shown in Fig 1 where *W* is a turned wooden support provided with a small shaft *X* and having in its periphery an iron hoop *Y* over which is slipped a copper hoop *Z* To be efficient the rotor must be made of a diameter as large as possible without touch

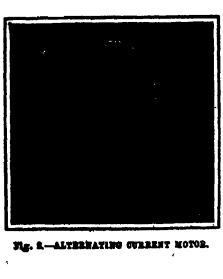


Fig. 2.—ALTERNATING CURRENT MOTOR.

ing the windings of the field It should be made to run true, and turn easily on its shaft.

The performance of the above experiments and of others that will be suggested by them can be made more interesting by studying the reasons why from some good textbook on the elements of alternating currents to which the reader is referred for a fuller explanation of the principles involved

DEVICE FOR REMOVING WOOD SCREWS.

BY JAMES PATERSON

In the Handy Man's Workshop department of July 31st a device for removing wood screws was described which struck me forcibly Another device for the same purpose has been designed by William Laycock, a weaving section hand in the Arlington Mills of Lawrence, Mass Quite often screws in the shuttle springs for holding down the spindle will break and the difficulty formerly was to get out these screws without injury to the shuttle, so Mr Laycock bethought him of an old screw-driver spindle, cut the point off, and then with a hacksaw cut two grooves in it at right angles as indicated in the illustration The grooves were made as wide as possible and fairly deep, leaving the edges sharp In use the tool thus prepared is pressed against the broken piece of screw and digs into it sufficiently to permit of turning and thus removing the screw

DEVICE FOR REMOVING WOOD SCREWS.

MENDING A BROKEN METALLIC FILAMENT

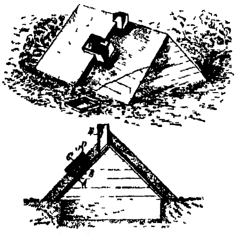
BY HOWARD W NICHOLS.

A carbon filament incandescent lamp, when the filament breaks, is of no further value, but in the case of a tungsten or tantalum lamp it is often possible to mend the filament so that the lamp will be nearly as good as new Place the lamp with the broken filament in a socket which is connected to the lighting circuit by a flexible lamp cord Turn on the current and gently shake the lamp so that the broken ends of the filament will strike against the main part and draw a small arc which will weld them securely to it and thus allow the current to pass through the filament, lighting it up brighter than before breaking This mending process usually cuts out only a small section of filament but if a comparatively large portion of the filament should happen to be cut out of the circuit, it would reduce the resistance of the remaining filament to such an extent that an excessive current would flow and thus soon burn the filament out. However while it lasted, the lamp would give a very bright light.

A SIMPLE FRUIT CELLAR.

BY F A. KAISER.

Doubtless many readers of the SCIENTIFIC AMERICAN have found it difficult to keep apples and the produce of their gardens such as carrots beets turnips, celery, etc, in perfect condition until they could be used. The accompanying drawings show a cheap and easily made fruit cellar in which I kept twelve bushels of apples besides carrots, squashes, and potatoes, from October until April My house was six feet wide, eight feet long and six feet high, and cost me about $4 Smaller ones can be built for a proportionally smaller sum.



A SIMPLE FRUIT CELLAR.

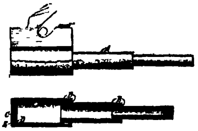
I dug a hole about eighteen inches deep and set the house over it, as shown in the cross section. The entrance is made like a box about twelve inches deep, so that soil or manure can be spread over the roof to a depth of about ten inches. Cleats A on the inside of the opening hold slats B at the bottom of the box opening. In the space C I stuff an old tick filled with straw or leaves Outside cover D protects the tick from moisture. The rafters should be about two inches square, or 1 x 2. Provide a chimney, E (of wood), which must be stuffed with straw during zero weather The chimney is not absolutely necessary, as the house can be ventilated through the door during mild weather The proper slant for the roof is about 45 deg., as earth can be packed on at that slope. Cover the roof with a cheap grade of building paper, or with newspaper, before putting on the earth, but do not use a paper that has a strong smell, like tar paper

I have had this house in use now during three winters, and it has saved me more than its cost every year Apples and vegetables keep fresh and plump in it, and do not shrivel up as they will in an inside cellar

HOW TO MAKE A PAPER TELESCOPE BARREL.

BY C. R. M'CARTY

The making of a paper telescope barrel is shown in the accompanying illustrations. First we make a wooden mandrel, A, that represents the various reductions in the barrel of the instrument. These portions of the mandrel are made of such diameters as to bring the interior of the barrel to the proper size Wrap on a layer or so of paper having a dull black finish so as to keep down any reflection of the rays of light on the interior of the instrument. When several layers of this paper have been carefully applied, Manila paper such as used by draftsmen in making pencil drawings should be laid on over it. It is understood that this paper is laid with glue between each layer, and this can be done to best advantage with the wooden mandrel placed between lathe centers. When the paper has been wrapped on to a thickness of about ¼ inch we shall have good substantial tubes. The exterior may be varnished or covered with cloth or paper of fancy pattern The stop pieces are simply rings laid on as shown at B When these stop rings have been placed in position the ring E is applied and glued fast, after which the lens is fitted against it and a second ring F is applied to hold it in place.



A PAPER TELESCOPE BARREL

These rings must be of dull black finish The eyepiece may be applied in the same way This makes a most excellent case for a telescope

RESTORING A DRY CELL.

BY DR. EDWARD H HANSON

Having experienced a great deal of trouble with the usual small cell batteries such as are used for medical wall plates, gasoline engines etc I have experimented until I have discovered a very simple method of restoring the ordinary dry cell sal ammoniac battery My method is as follows Midway between the carbon and zinc at the top of the battery drill a hole 3/16 inch in diameter down to within 1½ inch of the bottom of the cell On the opposite side drill a hole through the sealing wax covering 1/16 inch in diameter and 3 inches deep Place a small glass funnel in the large hole with the stem at least 2 inches long Into this pour one ounce C P hydrochloric acid After this is thoroughly absorbed pour in the funnel one ounce of water When all is absorbed seal the holes with ordinary stationer's sealing wax After twelve hours it will be found that the batteries so treated will work with increased voltage and amperage over a new dry cell. They will work well on either closed or open circuit and have from four to six times the life of a new dry cell I am using a series now that I employed in my office for three years and during that time have renewed them three times The batteries will work until the zinc pole is completely exhausted if the chemical elements are kept at the required strength by renewal

THE HANDY MAN'S SUB-CALIBER GUN.

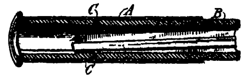
BY AUGUST MENCKEN

Those familiar with heavy artillery know that subcaliber work forms a very important part of the drill Very accurate work can be done by this method, but of course the range is very much shortened and the recoil and noise are missing.

Anyone having a large-bore rifle, such as the old model Springfield, and wishing to use it for short-range or gallery shooting, can sub-caliber it very easily in the following way

Take an empty regulation shell and bore out the head so that its inside diameter will be the same throughout its length. Then take a 0.32 caliber 3-inch revolver barrel—the hexagonal kind used in cheap revolvers is good enough for this purpose—and turn it up until it fits in the shell snugly but not so tightly as to swell the shell. Then carefully chamber the barrel to take the 0.32 cartridge. Great care must be taken in doing this, as the accuracy of the gun depends greatly on this part of the work. Next countersink the revolver barrel, B, so that the head of the 0 32 will lie flush with the head of the regulation shell A, as shown in the illustration. If this is not done the breech will not close and the shell may be accidentally exploded. Pins, C, should then be driven through the shell and barrel to keep the latter in place. This will not be needed if the barrel and inside of the shell are slightly tapered, the taper increasing from the muzzle end to the breech.

For ranges from 25 feet to 100 feet this method will work very well, and if the rifle is built so that a longer barrel could be inserted, of course its range would be increased.



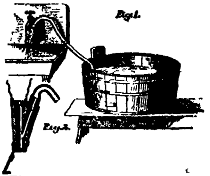
THE HANDY MAN'S SUB-CALIBER GUN.

A DEVICE FOR EMPTYING A TUB.

BY G. W FAIRBANK.

Considerable difficulty is often experienced in emptying and refilling the common form of movable washtubs. Stationary washtubs are usually provided with suitable plumbing connections whereby the water may be easily and quickly drained off, but with the ordinary form of wooden movable washtubs the entire tubful of water must either be lifted and carried to the sink or other drain to empty it, or the water must be bailed out of the tub and carried to the sink or drain by the pailful The lifting of the tubful of water is often a physical impossibility, and the carrying of the water from the tub to the sink by the pailful is a tiresome task If the house be provided with running water at the sink, a very simple contrivance may be devised for utilizing the city water pressure for the emptying of the tub By providing a simple form of ejector at the faucet and connecting one inlet of the ejector to a short piece of hose leading to the sink the water may be very easily drawn out of the tub into the sink, even though the latter be at a higher elevation In the accompanying sketch, there is shown a simple contrivance of this character, in which the ejector is formed of a block of wood adapted to be detachably secured to the faucet. The ejector includes two passages intersecting at an angle and having a common outlet as shown in section in Fig. 2 One of these passages receives a stream of water under pressure from the faucet, and the escape of this water from the lower end of the ejector tends to draw water out of the tub through the hose and to deliver the latter to the sink.

The same device may be used for refilling the tub. To secure this object, it is merely necessary to close the lower end of the ejector with a plug or in any other suitable manner As shown, a short rubber plug is connected to a strap tacked to one side of the block By inserting the plug within the open lower end of the passage and securing the free end of the strap to a button on the opposite side of the block, as shown in dotted lines the water will be caused to flow from the faucet down through one passage and up through the other to the hose and thence to the washtub.



HANDY METHOD OF EMPTYING A TUB.

An interesting experiment to determine whether the strength of iron and steel was affected by magnetism was carried out at the Technical Institute of Belfast with the following reported result Bars of mild steel and wrought iron 8 inches long by ½ inch to 1 inch in diameter were used, part of which were magnetized by being saturated in a solenoid. When tested, the elongation of the magnetized parts decreased 2 to 10 per cent, and the average breaking load [illegible] [illegible] increased.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

ELECTRICAL FUSE.—A. G. Fay, Highland Park, Ill. The fuse is for use in blasting, the more particular purpose being to protect the materials and containing shells of the fuse against moisture. To this end the invention relates to the addition of an outer shell and a filling, the size of the diameter of the outer shell being slightly reduced at one end therefor for sharpening the effect of detonation of the fuse.

Of General Interest.

BOAT.—F M Thompson, East Liverpool, Ohio. Among the characteristic features of this patent is a vertically rocking rudder or tail plate, the movement of which causes the prow of the boat to rise and fall in the water to a degree desired To overcome any suction and break up formation of vacuum at the plate the latter is made hollow and means are provided to discharge air into and through. Horizontal rudders or vertical axes are provided in front of the plate and in rear of the propellers for steering.

CRATE.—D F Payne, Corpus Christi, Texas. The invention relates to crates used for shipping the more particular purpose being to provide a type of crate which may be folded readily when not in use and provided with top and bottom members detachable from other portions of the crate and adapted to be sprung into position for the purpose of holding them into position.

WINDOW.—H Mortimer, New York, N Y This invention is an improved window, in which either the upper or lower sliding sash may be turned end for end and brought inward in the lower portion of the window frame where the outside of the sash is easily accessible for washing or other purposes, and a ventilating space between the sashes provided if desired.

RECORD-HOLDER.—W T Long, Sumner, Wash The object here is to provide a holder arranged to accurately and securely hold the record in central position to accommodate records of different sizes, to compensate for variations of the inside diameter of the records, to hold the record against accidental shifting in an axial direction and to allow placing it conveniently in position on the holder or removing it therefrom.

EMBALMING APPARATUS.—J E. Coppola, Mexico, Mexico. An object in this invention is to provide a simple apparatus capable of holding the liquid and compressed air in a reservoir, and devices for connecting the same with trocars or needles for injecting the fluid under pressure into a cadaver

FLASK FOR FORMING GATED MOLDS.—C W Blue, Montgomery Ala This invention provides a construction of flasks wherein the gated molds may be formed in tiers and the pattern members withdrawn therefrom, provides flasks wherein the cores may be inserted from the outside of the flask and held firmly in position, and provides a flask adapted to be mounted in tiers and arranged to accommodate molds of various sizes

DRY SEPARATOR.—B B Snowden, Houston Texas. The invention relates to mills, and the object is to provide a separator more especially designed for treating crushed phosphate rock and other materials so that the material in a revoluble screen is subjected to alternate brushing and jarring actions, to thoroughly separate the valuable material from the extraneous matter

SCREEN.—C J Jewett, Fort Smith Ark. The invention relates to screens which may be used for clay coal, or other materials, and an object is to provide a screen with adjustable screen bars, and means to move the bars to predetermined distances from each other Means prevent the material from becoming clogged between the screen bars

DAMPER-REGULATOR.—R. P Mitchell and R. V Brawley, Statesville, N C A spring is adjusted to retain a disk against predetermined pressure in the boiler Means permit the cylinder to exhaust, but should the pressure exceed predetermined value, means are provided to close or partially close the damper in accordance with the excess of pressure A valve is so elevated that a disk closes the inlet opening to the pipe, but when pressure falls, means permit the cylinder to exhaust, the piston to move downwardly, to allow a weight to swing the damper into open position.

PARALLEL-RULER.—F W Sperling Chicago, Ill The invention appertains to drafting instruments, and its purpose is to provide a new and improved parallel ruler, more especially designed for the use of navigators and other persons, to permit them to accurately and quickly transfer parallel lines when translating courses on a chart.

CIGAR PERFORATOR.—E. F Hall, Fowler, Cal. The improvement is in that class of perforators which are provided with a series of opposite points or prickers pivoted and arranged convergently in such manner that when the tip of a cigar is pressed down between them they enter the same and thus form lateral holes which assist in producing an easy draft.

WINDOW-VENTILATOR.—G. W. [illegible], Chicago, Ill. The inventor provides a device by which good ventilation is secured, while at the same time the ventilating opening is shaded without the necessity of using a projecting awning or other similar device. He provides a device which while permiting good ventilation prevents the rain or snow from entering while the device is in use.

Hardware.

WRENCH.—W A. Pratt, Stamford, Conn. This wrench is adapted for screwing up or unscrewing caps or jars and other packages, and for loosening the caps from the rubber or other packing rings, it being adjusted for gripping objects of various sizes, and having handled V-shaped jaws pivotally connected with each other at their ends and a supplementary jaw adjustably and removably attached to one of the jaws to co-act with the opposite jaw

WOODWORKER'S PLANE.—J H Brown, Boston, Mass. The intention here is to provide for a plane that facilitates the exact adjustment of the cutter bit laterally and longitudinally in the throat of the plane stock, enable the quick and exact graduation for size of the throat opening in the stock, provide means for clamping the cutter bit when adjusted in the throat opening

TUBE-CUTTER.—O B Young Riverhead, N Y The invention is useful for various different purposes and particularly in facilitating the removal of defective tubes in a boiler or similar tubular structure In a boiler access cannot easily be had to the exterior of the tube and some difficulty is experienced in removing the tube unless it be cut in two from the interior

COMBINATION TOOL.—W J Tweedale, Saginaw, Mich. The intention in this case is to provide a wrench of ordinary construction, with attachments whereby it may be used as a pipe wrench or a drill or a turning lathe and for many other purposes The handle may slip out of the extreme end of the shank so as to give room between the jaws for the drill bit.

Heating and Lighting.

CORE-OVEN.—J J. Johnson Newark, N J The invention relates particularly to core ovens used for drying or baking cores used in molding. The object is to produce an oven which will be simple in construction, the temperature of which can be nicely regulated, and which will have a construction which will enable the oven to be kept constantly filled

ILLUMINATING SIGN.—J F Dudas, Buffalo, N Y This invention relates to advertising signs such as those hung out in front of stores or shops to indicate the business done therein. An object is to provide an illuminated sign which can be read at night from a considerable distance with ease and which can be equally as well read in the daylight.

Machines and Mechanical Devices.

COMPUTING PUMP.—S. G Wise and J E. Troyer, Jr., Gas City, and J E. Smisor, Marion, Ind. The invention refers to computing pumps, and more particularly to pumps designed to be used in dispensing and selling fluids such as oil and the like When one gallon of fluid is pumped by the pumping mechanism one gallon is registered by the computing mechanism When one gallon has been forced through the casing, the dial has made a complete revolution.

VENDING MACHINE.—F A. Slichter, Kansas City, Mo. The aim of the inventor is to provide a machine more especially designed for use in stores and other places, and arranged to allow convenient delivery of the merchandise in predetermined quantities, without danger of packing and obstructing the rapid flow of the merchandise, such as seeds of various kinds.

AIR-SHIP.—A. E. G Lubke, San Francisco, Cal An object here is to provide a ship having an aeroplane and a balloon or gas bag connected therewith, together with an improved steadying means. A further object is to provide a balloon composed of one or more separate gas bags inclosed within a shell or chamber having means for regulating temperature. The propellers may be caused to rotate horizontally or vertically

FEED MECHANISM FOR BORING MACHINES.—A. Frey, Schöftland, Switzerland. The inventor provides a mechanism capable of being quickly changed for use as a hand feed or an automatic feed, and arranged to permit convenient changing of the gearing so that the feed mechanism for feeding the boring tool may be run at any desired speed according to the nature of the stock to be bored.

Prime Movers and Their Accessories.

ROTARY ENGINE.—F O Biehl, Wilkinsburg, Pa. In this case the inventor's desire is to produce an engine in which the various parts are designed to permit of exact adjustment for controlling the motive fluid to permit of utilizing the expansive force of the fluid to a greater or less degree, and has had in view the construction of an engine which will permit of the use of as many cylinders as desired.

Railways and Their Accessories.

SAFETY SWITCH LOCK.—A Haddock and A Schmitt, New York, N Y An object here is to provide a lock which can be used in connection with various switch systems and block signal systems without interfering with the operations thereof, and which serve to lock a switch either open or closed as set by the switchman so that the switch cannot be accidentally displaced while a train is approaching the switch or passing over the same.

LOCOMOTIVE-HEADLIGHT.—I L. Wade and W L. Smith, Roanoke, Va. In the present patent the invention is an improvement in that class of locomotive headlights which are pivoted and so connected with the front truck as to be turned with the latter in passing around curves. The headlight, yoke and arms may be readily detached when required.

SNOW PLOW.—C A Belland, Fairdale N D The object here is to produce a snow plow which will effectively operate to cut the snow from the railroad track and eject it at the side In its general construction the plow comprises a pair of cutter wheels which are mounted at a forward point, and behind these cutter wheels an apron is provided which assists in throwing the snow rearwardly into a drum from which it is discharged laterally or at right angles to the track.

Pertaining to Recreation.

SOCKET POST FOR SUPPORTING CROQUET ARCHES.—H B Collier Prairie Grove Ark The purpose of this inventor is to provide novel details of construction for a socket post which adapt it in pairs for a secure embedment in the ground at suitable points in upright positions, and for the convenient insertion of the limbs of a croquet arch thereinto, and thus afford stable support to the arch in a vertical plane and permit the removal of the arch.

Pertaining to Vehicles.

AUTOMOBILE-PROTECTOR.—D F Armstrong Groton, Conn The invention relates more particularly to protectors such as are adapted to be arranged on the steering posts of automobiles to protect the drivers. It can be easily secured to the steering column of an automobile and fitted with either a transparent or a translucent shield to protect the driver

WHEEL.—L. Y León San Juan, Porto Rico. The invention relates to wheels for general use, the more particular purpose being to provide a wheel suitable for a road vehicle, and having a considerable degree of resilience due to the type of springs employed within the wheel and to the manner in which they are mounted and kept in position.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper

Notes and Queries.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of March 18th or will be sent by mail on request.

(12127) A. C Co asks We would like to get an approximate idea of the amount of coal burned by the average ocean going vessel of 700 tons net registry drawing from 9 to 15 feet, that is to say, the amount of coal per hour burned in producing a speed of from 10 to 15 knots A It is impossible for us to give a reply to your question equally accurate and general for all cases for the reason that coal consumption per horse power varies so much with the efficiency of both engines and boilers, and horse power for a given speed varies so much with the lines of the boat. For instance a 700 ton yacht with fine lines might be driven at a speed of 10 knots with half the horse power required to give the same speed to a cargo boat of the same displacement and as the boiler and engines of the yacht might easily have 50 per cent higher efficiency (say 30 per cent efficiency as compared with 20 per cent) the yacht might make the same speed as the cargo boat with one third of the latter's coal consumption Again every steamship has its maximum economical speed and whereas a given quantity of coal may drive it a little greater distance at a lower speed any attempt to drive it at a higher speed will cause an increase of coal consumption out of all proportion to the increase of speed gained. There might therefore be a great difference between coal consumption at 10 and at 15 knots, and a boat of which the former was the economical speed might be unable to achieve the latter with any reasonable coal consumption if at all Although you only ask for an approximate idea, we must therefore make this reservation to show you how widely an average figure may vary from that of your particular case. If you gave tonnage, economical speed, and horse-power we could give a fairly close figure for average lines, but knowing neither lines nor horse-power the chances of wide disparity are multiplied. With the foregoing reservation, we may say that the average coal consumption of three nominal 10-knot boats of 700 tons displacement in actual service, within our knowledge is 9 tons per day The horse-power of these ranges from 400 to 600 and averages 500, which represents 1.5 pound of coal per hour per horse power which is good marine practice for any except the most efficient multiple-expansion engines. Only one of these boats has ever been or could be driven at 15 knots, and that was as an experiment and necessitated a consumption of 3 750 pounds of coal an hour or nearly five times the economical consumption.

(12128) N V V says Being a constant reader of the Scientific American I take the liberty to ask you the following question If it takes 10 tons of coal to run a locomotive 100 miles in 10 hours how much coal would it take to run the same engine the same distance in 5 hours? I claim that as based upon the mechanical rule what you gain in speed you lose in power it ought to be about the same amount. A It is impossible to answer your question exactly without a great deal more detail as to the locomotive the load hauled, etc. but speaking generally, the fuel consumption is likely to increase out of all proportion to the speed, if the latter is increased above the economical speed of the engine Each engine has a certain maximum speed at which it can haul a given load economically, and whereas with a given quantity of coal it can haul the same load a greater distance at a lower speed, at a higher speed the coal consumption increases very much more rapidly than the speed. For instance an engine burning 1,930 pounds of coal per hour at a speed of 40 miles per hour uses 3 400 pounds per hour in hauling the same train 60 miles per hour nearly doubling the coal consumption for a 50 per cent increase of speed, and 3 920 pounds at 70 miles per hour These are figures from an actual test, the coal consumption varying directly with the horse-power expended In your case however 10 miles an hour is not likely to be the economical speed of the locomotive and it is probable that it could cover 100 miles in 5 hours with the same or very little more coal than it would take to cover the same distance in 10 hours.

NEW BOOKS, ETC

Astronomy of the Bible An Elementary Commentary on the Astronomical References of the Holy Scripture. By E Walter Maunder F R A S New York Mitchell Kennerly, 1909 34 ill

Mr Maunder's attitude toward the celestial miracles of the Bible does not differ essentially from that of the average non astronomical Christian He frankly regards the Bible as an inspired utterance Although he does not hesitate to present the scientific theories which have been advanced to account for such miracles as Joshua's Long Day the Dial of Ahaz and the Star of Bethlehem he is more prone to consider them as divine portents rather than as ordinary astronomical occurrences. He constantly reminds us that the Scriptures were not intended to teach us the physical sciences for which reason in his opinion it is almost futile to offer scientific explanations of Biblical miracles In the case of the Star of Bethlehem, for example Mr Maunder is inclined to accept the miracle and although he presents the usual theories of a conjunction of planets a comet and a nova to account for the apparition he regards the Star of Bethlehem as a specially designed miracle for the guidance of the Magi

Statistical and Chronological History of the United States Navy, 1775-1907 By Robert Wilden Neeser, Fellow of Yale College In two volumes. The Macmillan Company 1909 Quarto, 650 pp Price, $12 net.

In spite of the many books that have been written on the history of the United States navy it is the opinion of the author that the record is yet incomplete Hence he has undertaken the task of historian upon a scale of research and completeness that leave nothing to be desired going back as far as possible to the original authorities, and—a most important feature giving these authorities in the text The completed work will be divided into five parts. The first three parts, here offered are complete in themselves, and contain data concerning every engagement capture expedition or other achievement of the navy prior to January 1st, 1907 The remainder of the work may be considered as supplementary This is a monumental work carried out with great fidelity

Nelson and Other Naval Studies By James R. Thursfield, M A. New York E P Dutton & Co. 374 pp Price, $4

Unlike so much of the literature of the life of Nelson the present work was written by a civilian The fact of his reviewing the life of a naval officer from the outside as it were gives a new point of view and serves to bring into relief certain features which are apt to be overlooked by the professional naval writer Although the battles of the Nile and Copenhagen receive adequate notice the Battle of Trafalgar naturally takes the first place. Mr

Thursfield's idea of the plan of attack at Trafalgar differs somewhat from those commonly accepted but after reading what he has to say the impression is deepened that at Trafalgar as in many other fights of that day the plan of battle as outlined before the fight was greatly modified to suit the exigencies of the hour This work will possess a particular interest for American readers, because so large a portion is devoted to an appreciative survey of the achievements of John Paul Jones. Mr Thursfield is the first English writer of prominence to remove the stigma which was attached to Jones's name by the calumnious writers of his day, and reveal him as the admirable character that he was. One of the most valuable chapters is that in which full justice is done to Admiral Duncan, the hero of Camperdown whose exploits and general professional ability seem never to have received adequate recognition until late in his career

SECOND APPENDIX TO THE SIXTH EDITION OF DANA'S SYSTEM OF MINERALOGY By Edward S Dana and William E. Ford. New York John Wiley & Sons, 1909 8vo., 114 pp. Price, $1 50

During the ten years of mineralogical investigation which this appendix covers, a large amount of material has been published An evidence of this is to be found in the two hundred new names which are given in the classified list in the introduction. About sixty of these new names on account of the completeness of their descriptions seem to have a warrant for their acceptance as new species. The other names are either of imperfectly described minerals or variety names of well recognized species. The descriptions of the new species included in this book are given concisely but completely It was found, however, impracticable to follow the plan adopted in the System and the First Appendix of recalculating all the angles and crystal constants of the new species. This has been done in a few cases, but in the majority of the descriptions the figures of the authors have been accepted without verification In the cases of some of the new species with complex crystals it has been impossible to give the complete lists of the forms identified upon them. The method followed has been to give the more common and prominent forms and to indicate the number of those not listed.

THE MAKING OF SPECIES. By Douglas Dewar, B A. and Frank Finn B.A. New York John Lane Company 1909 8vo 400 pp Price, $2 50, postage extra.

The authors aim in writing this book has been twofold In the first place they have attempted to place before the general public in simple language a true statement of the present position of biological science and in the second place they have endeavored to furnish the scientific men of the day with food for reflection As the British nation seems to be slowly but surely losing through its conservatism the commercial supremacy it had the good fortune to gain during the last century, so is it losing, through the unwillingness of any of her scientific men to keep abreast of the times, that scientific supremacy which she gained in the middle of the last century by the labors of Charles Darwin and Alfred Russell Wallace It is not among Englishmen but among Americans and Continentals that the world has to look for advanced scientific ideas. The authors fear that this book will come as a rude shock to many scientific men. What they attack is not Darwinism, but that which is erroneously called Neo Darwinism. Neo-Darwinism is a pathological growth on Darwinism which we fear can be removed only by a surgical operation The book is a beautifully printed one and will doubtless interest all naturalists.

THE ELEMENTARY PRINCIPLES OF INDUSTRIAL DRAWING. By George Jepson Oblong 12mo 28 pp, 11 plates.

The aim of this little book is to present the subject of industrial drawing, so that a student after he has become familiar with its contents, will have mastered all the essential principles as applied to mechanical and architectural drawing While the book presents all the principles of industrial drawing it is not a graded course of lessons, although if desired an elementary or more advanced course can be compiled from its contents. The author is an instructor in descriptive geometry machine drawing and shop work in the Massachusetts Normal Art School and was for many years master of the Evening Science School of the city of Boston The book appears to be an excellent one.

HENDRICKS'S COMMERCIAL REGISTER OF THE UNITED STATES FOR BUYERS AND SELLERS. New York Samuel E Hendricks Company 1909 Quarto, 1220 pp. Price $10

This is the eighteenth annual edition of Hendricks's Commercial Register of the United States. It is a complete and reliable annual index of industries, containing over 350,000 names and addresses of buyers and 38,000 business classifications Full lists are given of manufacturers and dealers in everything employed in the manufacture of material, machinery and apparatus used in these vast industries, from the raw material to the manufactured article and from the producer to the consumer. It is indispensable as a work of reference for the architect, engineer, contractor, manufacturer, jobber, retailer, exporter, purchasing agent, and for the railroad machine shop, foundry, mill, factory, mine, and plantation We have occasion to use several copies of this book, and it answers a vast number of our inquiries for manufacturers. It is a book which we can thoroughly commend.

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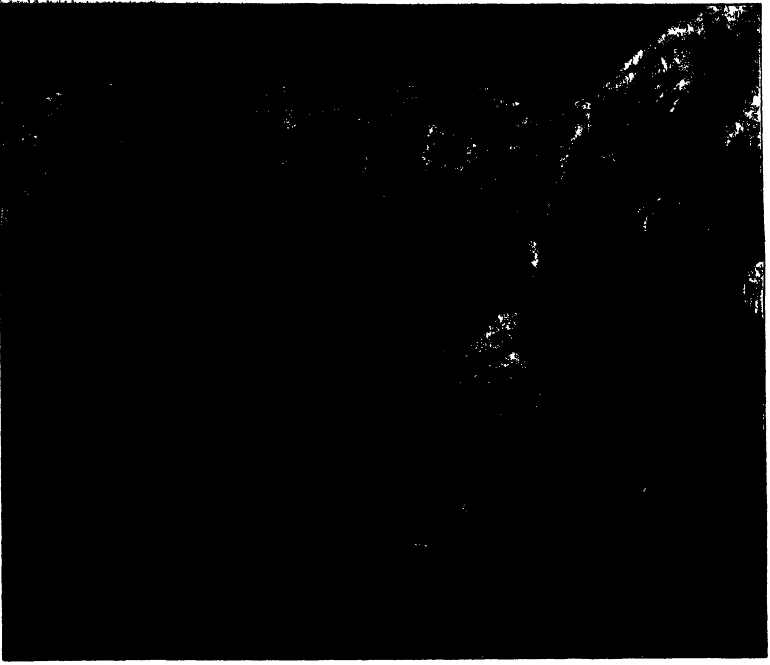
Generators, sludge faucet for carbide gas, F L. H Sims	[illegible]
Glass, apparatus for making sheet or plate, J J Quertinmont	[illegible]
Glass articles, machine for making hollow, P T Sievert	[illegible]
Glass machine, wire, M Franzen	936,880
Glass, method and apparatus for making wire, J. J Quertinmont	[illegible]
Glass, process and apparatus for making wire J J Quertinmont	[illegible]
Glass tube cutter C. E. Skinner	[illegible]
Glove pocket Fields & Noble	[illegible]
Gold dredges, collecting means for, T J Barbour	[illegible]
Golf club bag F C. Breakspear	[illegible]
Grain drill L. R. Robey	936,741
Grain spout, C L. Gardner	936,772
Graphite lubricator F G Wilson	936,870
Graphophone T H Macdonald	936,646
Grease cup, compression L. W Durst	936,922
Grinding machine, A. C Warner	937 085
Grinding milling cutters or similar tools, machine for F A Kustner	[illegible]
Grinding pan Middleton & Cobbe	936,794
Gun R. H Searle	[illegible]
Guns, hand grip for F A Freeman	[illegible]
Hammer power W Graham	936,916
Handcuff M Mitchell	936,797
Hanger See Wire hanger	
Harness and warp stop motion, combination Amner & Marnel	936,947
Harvester pea A. McMahon	936,725
Harvester potato, J Load	[illegible]
Hat brim press to form welt edges, C. R. Sackett	[illegible]
Hat hook A M. Hortenbach	[illegible]
Hay gatherer, N Fryman	936,621
Hay retainer C H Whitney	[illegible]
Heat means for utilizing solar M L. Severy	937,018
Heels, making boot and shoe, W P, Bosworth	[illegible]
Hide supporting device, H. S. Crumble	[illegible]
Hoe seeder L. A Sandoe	[illegible]
Hoist portable, Klaus & Gudient	[illegible]
Holder I Hanfelder	[illegible]
Holding attachment, G. P Schmidt	[illegible]
Horn, H J Kingsley	[illegible]
Horses, ice creeper for, I. R. Whisler	[illegible]
Horseshoe calk, J R. Dolan	[illegible]
Hose cock, H. Vinette	[illegible]
Hose coupling, N M Rosendahl	[illegible]
Hose coupling, A. A. Hill	[illegible]
Hose coupling R. J Hanbold	[illegible]
Hose support, J. W Fitz Gerald	[illegible]
Hot air register, R. C Fox	[illegible]
Hypodermic medication, means for, B. G Strong	[illegible]
Ice cream freezer Thomsen & Schmitt	[illegible]
Ice, device for cutting plate, R. H Kirk	[illegible]
Ice making and harvesting apparatus, plate, D. J Havenstrite	[illegible]
Ice, manufacturing and harvesting, R. J Berryman 936,978,	936,979
Ice manufacture of artificial R. J Berryman	936,977
Igniters or sparkers, timer for H Rose	[illegible]
Implement holder R. C Lawlor	[illegible]
Incubator electric alarm, G. L. Kulp	[illegible]
Index compiling device, W A Antilotti	[illegible]
Induction motor, S. E. Bergman	[illegible]
Induction motor C Robinson	[illegible]
Insulator, electric, J. A. Welts	[illegible]
Internal combustion engine R. Chapman	[illegible]
Jar holder W J McCallum	[illegible]
Jars, device for releasing the caps or covers for glass fruit, G R. Searing	[illegible]
Journal box, J G Smith	[illegible]
Journal box, adjustable, P J. Joechen	[illegible]
Journal boxes, means for packing waste in, L. G. Condit	936,904
Junction, wall, floor or other box, D. Coplan, Jr.	[illegible]
Keel block, H. Stocks	[illegible]
Kilns, disintegrating and removing clinker accumulations in, A. Breckel	[illegible]
Knife, E. J Wilson	[illegible]
Knob attachment A. H. Franklin	[illegible]
Knob, glass, G W Graham	[illegible]
Knockdown box, R. A. Simpson	[illegible]
Lacing hook making machine, [illegible]	[illegible]
Lacing hook or stud setting machine, [illegible]	[illegible]
Ladder, F. L. [illegible]	[illegible]
Ladder, [illegible]	[illegible]
[illegible]	[illegible]



FOUR INTERESTING LETTERS

PEARY

NEW YORK June 19th, 1908

Dear Sir —In regard to the watches furnished me by the Waltham Watch Co three years ago, the behavior of the meantime watches was particularly excellent

Watches carried by men in charge of different parties on the sledge journeys over the sea ice ran for weeks without any considerable variation from each other This feature was a very distinct comfort to me in making me feel sure of my observations when the drift of the ice had carried me far away from all dead reckonings

Most of these watches are now on Eagle Island Maine, where I am going the end of this week I will endeavor to get them on to you as soon as possible . . Very sincerely,

(Signed) R. E PEARY, U S. N

Mr. James W. Appleton.

WELLMAN

WASHINGTON D C Nov 27th 1899

AMERICAN WALTHAM WATCH CO Waltham Mass

Gentlemen —The nine watches made by you which were carried in the Wellman Polar Expedition proved entirely satisfactory Two of these were injured slightly by the Norwegian sailors in the early winter The remaining seven were used by me in ascertaining time and also positions of latitude and longitude Position of stars computed by the aid of these watches could be depended upon to the accuracy of a second Positions of longitude ascertained by Julius Payer twenty five years previously were verified

Extreme cold affected the movements but slightly and in no way injured them After returning to Norway but slight discrepancies were found upon comparing with Greenwich time

In my judgment these movements are thoroughly reliable for any use and in any clime being thoroughly compensated Yours truly

(Signed) QUIROF HARLAN
Physicist to Wellman Polar Expedition

The Shackleton Relief Expedition

BRITISH ANTARCTIC EXPEDITION 1907

S Y Nimrod
LYTTELTON 27th March 1909

MESSRS R W CAMERON & CO Wellington

Sir Herewith I forward to you per Purser S S Maori the seven Waltham watches so generously loaned to my officers and self by your Company for our use in the Antarctic

Two of them unfortunately have been damaged One of them by an accident down a crevasse and the other during a sledge journey

My officers and I found the watches reliable under all conditions After a time we gained so much confidence in their rates that we had no hesitation in trusting to them when taking observations which required time-readings to seconds

On their behalf and my own I beg you will convey to your Company my thanks for the use of the watches I am Sir Yours faithfully

(Signed) FRED P EVANS Lieut R N R
Officer Commanding

LEFFINGWELL

The Quadrangle Club, CHICAGO, Dec 8th 08

MR. R. A. MARSH, Waltham Watch Company.

Dear Sir —About three years ago your Company loaned me four of your watches for use on the Anglo-American Polar Expedition I received them from Robins, etc here and yesterday I returned three of them to the same people I wrote to you from the North last summer telling of the remarkable performances of these watches and my private Waltham during a two months sled trip over the ice They were compared with each other and chronometer corrected by observation nearly every day for a year and rates assigned for the ice trip Daily comparisons were made among the watches on the trip also, and with the chronometer after our return The field rates were found to be practically the same as those assigned from the rates during the several months previous to the field trip If it were not that all three watches came out the same, I should say that the obscure field rates were accidentally close to the calculated rates The performance of your watches is emphasized by the fact that Capt Mikkelsen had a hand-made pocket chronometer made to order in London at a cost of $250 00 On this trip this expensive time-piece varied so greatly from the mean of the other watches that it had to be disregarded after the first week The rates of your watches were changed but a fraction of a second, while the Captain s watch increased 35 seconds in its daily rate

I took the greatest care in getting the best possible performance from the watches I wore two myself and insisted that others took good care of them The watches were worn night and day next to the skin and every precaution taken to keep their temperature constant

Thank you very much for your kindness to us in loaning the watches Yours etc (Signed) E DE K. LEFFINGWELL

N. B.—In buying a Waltham Watch always ask your jeweler for one adjusted to temperature and position

Lamp, aseptic defector, G. G. Werner 936,490
Lamp attachment, vehicle, A G Thomson 936,421
Lamp, blast, L. Schemnitz 936,515
Lamp bracket, adjustable C. H. Stevens 936,379
Lamp, electric, G L. Van Wart 936,747
Lamp, incandescent gas, A. Hector 936,470
Lamp, incandescent gas, O Wiederhold 936,801
Lamp socket cluster H. J S. Lewis 936,498
Lamp socket cluster H. B. Benjamin 936,519
Lamp working apparatus, Loew & Silvernail 937,005
Lamps making filaments for electric incandescent W von Bolton 936,408
Lathes, turret tool holder for J Hart 936,501
Laundry iron electric H G Newman 936,556
Lead pipe reinforced H. F Wardwell 936,659
Lens holder J B Schrock 936,368
Leveling instrument hydrostatic, J J Bunting 936,407
Lids or covers having headed rims, device for drawing and pressing K Christian 936,606
Life saving apparatus P Kotlar 936,546
Lifting jack J E. Crowle 936,809
Light fixtures turnkey for, R. M Bryne 936,518
Liquid dispensing device M M Marcuse 936,384
Liquids, concentrating G W Childs 936 760
Locomotive O N Terry 936,563
Locomotive boiler G Cook 936,607
Locomotive engine Cole & Scoville 936,418
Log skidding machine J R McGiffert 936,685
Lugs, machine for making heel W P Bosworth 936,558
Loom dobby, H H Ryon 936,479
Loom shuttle changing R. H Ryon 936,940
Loom temple W H Kynett 936,489
Loom terry motion J L. Davidson 936,810
Loom weft replenishing H N Arthur 936,510
Looms bobbin for filling replenishing F Dion 936,624
Looms center selvage mechanism or attachment for A A Gordon Jr 936,445
Looms thread changing apparatus for L. J Arnaud 936,524
Looping machine C. Holly 936,698
Mail bag crane A H Stone 936,460
Mail box holder J H Fisher 936,537
Mail pouch catching and delivering means, Gurwitch & Rainey 936,716
Malt drying apparatus, W H Prinz 937 011 937 012
Malt kiln R Roth 936,947
Manifolding pad H K Bottle 936,697
Mat See Door mat
Match box automatic W A. Carter 936,808
Mattress and furniture spring F J Mauborgne 936,649
Measuring instrument A H Lucas 936,781
Measuring or indicating instrument C H Veeder 937,015
Melting apparatus, Carr & Speer 936,759
Melting furnace and using the same Carr & Speer 936,758
Metal bluing H E Sheldon 936,831
Metal composite J G Mellen 936,339
Metal permanent magnetic E. R. Gertler 936,580
Metal plate bending machine, T C. Scheid 936,461
Metal rod cutting machine, G H Scott 936 572
Metal treating F L O Wadsworth 936,389
Metals plating W Griffith 936,712
Metals, treating H D Miller 936,660
Meter seal Burgess & Londick 936,868
Micrometer gage for fine measurements, H A Reynolds 936,667
Milking machine, G E Jonson 936,907
Milking machine adjusting device E. V Gandil 936,771
Milling double helical toothed wheels, machine for C. Wust-Kunz 936,972
Mine firing device T O Hallam 936,565
Minerals, device for preventing waste of Smith & Kongall 936,577
Mining drill, J R. Place 936,937
Mitering machine attachment, W W Purcell 936,355
Mixing apparatus, G F Dickson 937 023
Molding machine R, H Ryon 936 549
Monogram holder J L. Des Lauries 936 766
Mop, J F McLaughlin 936,655, 937 007
Mortise marking device C, Sturts 936 579
Motor controller electric O F Shepard 936,852
Mower J T Fritsche 936 861
Nozzle, spraying A B. Hull 936,537
Nut lock, F Braune 936,299
Nut lock, J B. Lambeth 936,881
Nut lock F Moser 936,553
Nut lock D. E McDonell 936,929
Oar lock T C Lace 937 004
Oil and air, apparatus for supplying heating and burning crude H E. Weaver 936,698
Oil burner W Scringeour 936,748
Oil burner H S Milks 936,923
Oil waste cleaning apparatus Orkin & Isaacs 936 657
Oiler road C M. Haeske 936,716
1-para-dialkylaminoaryl-2-4-dialkyl-5-oxymethyl-5-pyrazolone, Stolz & Streitwolf 936,880
Ore pulverizing and amalgamating apparatus R. Luckenbach 936,645
Ores amalgamating and separating metallic R. Luckenbach 937 068
Outlet or junction box C T Pratt 936,809
Oven continuous baking E. Jacobson 937 000
Packing D E Paterson 936,656
Packing machine J Merritt 936,799
Packing piston J J Hampson 936,717
Paddle wheel feathering J Rourke 936,478
Padlock L. A. R. C Byrne 936,663
Paint varnish and finishes removing J M Wilson 936,948
Pamphlet coverer G Bague 936,490
Paper apparatus for protecting commercial R. E Angell 936,796
Paper bag M Vierengel 936 585
Paper box machines paste applying mechanism for A W Mitchell 936 746
Paper feeding machine T C Dexter 937 024
Paper marked L. J Trounstine 936,959
Paper protecting commercial R. E. Angell 936,360
Pavement and making the same J C Traville 936,403
Pedal action player grand, Hattemer & Kuhle 936,686
Pedal mechanism A G Gulbransen 936,447
Pen and pencil holder pocket J P Randall 936,941
Pencil making machine, R. H Howard 936,729
Pencils and the like thumb rest for S. G. Donovan 936,669
Percussive machine and tool W Mauss 936 860
Phonograph attachment L. H Hays 936 534
Phonographic reproducer R H Smith 936 836
Photographer's light refractor W G Farrand 936 707
Photographic apparatus, H B. Jordan 936 429
Piano pedal automatic J W Darly Jr 936 763
Piano, self playing Long & Tapper 936,764
Piano, self playing W B Bartlett 936,801
Piano sounding board F B Long 936,750
Piling sheet A A Friestedt 936,530
Pipe cigar holder etc, J B Perry 936,784
Pipe coupling train W M Hiler 936,394
Pipe expanding tool R. F Wardwell 936 658
Pipe slip joint C D Milne 936,449
Pipe tapping machine W R Ford 936,418
Pipe wrench A A Patton 936 304
Pitcher P Pullard 936,836
Planers and other machines, electrical controlling means for A P Steckel 936,877
Planers, feed roll controlling mechanism for wood H A Perkins 936,670
Planers, lathes etc cutting tool for C R Middleton 936,798
Plant protector W L. Baldridge 936,401
Plant support W S. Beasley 936 619
Planter onion seed, B V Garwood 936,863
Planters, differential dropper mechanism for corn, F P. Murphey 936,471
Plow L. W Newton 936,346
Plow J. Brev 936,590
Plow and planter, combined lister Shearer & Kirk 936,466
Plow attachment, E. B. Van Winkle [illegible]
Plow draft attachment, C. P. Simons [illegible]
Plow, sulky, E. G. Field 936,789

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A SIMPLE METHOD OF TEACHING EXPERIMENTAL PHYSICS.

(Continued from page 296.)

taneously The needle traces an undulating line which cuts the base line in a series of points whose distances from the zero point are proportional to 1, 4, 9, 16, etc., that is, to the squares of the times. In this way the laws of falling bodies can be verified to within 1 per cent. This is a much closer approximation than can be obtained with Atwood's or Morin's apparatus, with which the beginning and end of the fall cannot be determined very accurately.

In other experiments the drum is driven by a cord, passing over the pulley and a grooved wheel 6 inches in diameter, attached to a simple driving clock, such as is used to turn a spit. With this arrangement the gradual diminution of the amplitude of successive oscillations of the pendulum, and the more rapid diminution brought about by attaching to the pendulum a paddle dipping into water, can be studied. The isochronism of small oscillations can be shown by giving the drum a uniform velocity of rotation, by means of the driving clock or of a weight which is stopped after it has fallen a certain distance. Then the base line and the undulations having been traced as before, the wave length, or distance between consecutive intersections of the two lines, is found to be constant, no matter what the amplitude or height of the wave may be, provided that it is small.

Chassagny's apparatus for compounding vibrations in the same plane (Fig 2) comprises two wheels mounted on parallel shafts. The first wheel is turned by a crank and drives the other by means of a belt. The ends of a fine violin string are attached to pegs inserted in the faces of the wheels at unequal distances from their centers, and the middle part of the violin string, which is kept taut by a spring, passes round a pulley, which turns freely on a vertical rod, attached rigidly to the horizontal axle of the nave of a bicycle wheel mounted in bearings. When the crank is turned both wheels revolve, and the horizontal displacement of the pulley, at any instant, is equal to the algebraic sum of the horizontal displacements of the two pegs. The movement of the pulley is followed accurately by a writing point which is attached to the other end of the bicycle nave. This point presses against a strip of smoked paper wrapped round a drum, which is turned by the engagement of a toothed wheel on its shaft with an endless screw on the crankshaft. The amplitudes of the two vibrations whose combined effect is sought are varied by varying the distances of the pegs from the axes of the two wheels, the phases are varied by setting one wheel, at the start, more or less in advance of the other by means of pointers attached to the wheels and fixed graduated circles behind them, the periods are varied by employing wheels of diameters proportional to the periods desired. For example, two wheels of nearly equal diameters give a graphical record of the phenomena of "beats."

Vibrations in mutually perpendicular planes are combined by means of an apparatus based on the same principle (Fig. 3) The resultant curves are traced on smoked glass so arranged before a lantern that the curves can be immediately projected on a screen and explained and studied at leisure, with a thoroughness that is not possible with the evanescent projections of Lissajous's figures made in the usual way, by reflecting a pencil of light from mirrors attached to tuning forks.

Chassagny's apparatus for the study of refraction consists of a glass globe supported by fixing its horizontal neck in a copper sleeve. If the neck is regarded as one pole of the globe, the opposite pole is indicated by an interruption in a copper meridian, and the equator is graduated in intervals of five degrees. Water is poured into a funnel attached to the upper side of the neck until its [illegible]

(Continued on page [illegible].)

Home-Made Experimental Apparatus

In addition to the following articles, the Scientific American Supplement has published innumerable papers of immense practical value, of which over 17,000 are listed in a carefully prepared catalogue, which will be sent free of charge to any address. Copies of the Scientific American Supplement cost 10 cents each.

If there is any scientific, mechanical, or engineering subject on which special information is desired, some papers will be found in this catalogue, in which it is fully discussed by competent authority.

A few of the many valuable articles on the making of experimental apparatus at home are given in the following list:

ELECTRIC LIGHTING FOR AMATEURS. The article tells how a small and simple experimental installation can be set up at home. Scientific American Supplement 1551.

AN ELECTRIC CHIME AND HOW IT MAY BE CONSTRUCTED AT HOME, is described in Scientific American Supplement 1566.

THE CONSTRUCTION OF AN ELECTRIC THERMOSTAT is explained in Scientific American Supplement 1566.

HOW TO MAKE A 100-MILE WIRELESS TELEGRAPH OUTFIT is told by A. Frederick Collins in Scientific American Supplement 1605.

A SIMPLE TRANSFORMER FOR AMATEUR'S USE is so plainly described in Scientific American Supplement 1572 that anyone can make it.

A ¼-H.-P. ALTERNATING CURRENT DYNAMO. Scientific American Supplement 1558.

THE CONSTRUCTION OF A SIMPLE PHOTOGRAPHIC AND MICRO-PHOTOGRAPHIC APPARATUS is simply explained in Scientific American Supplement 1574.

A SIMPLE CAMERA-SHUTTER MADE OUT OF A PASTEBOARD BOX, PINS, AND A RUBBER BAND is the subject of an article in Scientific American Supplement 1578.

HOW TO MAKE AN AEROPLANE OR GLIDING MACHINE is explained in Scientific American Supplement 1582, with working drawings.

EXPERIMENTS WITH A LAMP CHIMNEY. In this article it is shown how a lamp chimney may serve to indicate the pressure in the interior of a liquid; to explain the meaning of capillary elevation and depression; to serve as a hydraulic tourniquet, an aspirator and intermittent siphon; to demonstrate the ascent of liquids in exhaustive tubes; to illustrate the phenomena of the bursting bladder and of the expansive force of gases. Scientific American Supplement 1583.

HOW A TANGENT GALVANOMETER CAN BE USED FOR MAKING ELECTRICAL MEASUREMENTS is described in Scientific American Supplement 1584.

THE CONSTRUCTION OF AN INDEPENDENT INTERRUPTER. Clear diagrams giving actual dimensions are published Scientific American Supplement 1615.

AN EASILY MADE HIGH FREQUENCY APPARATUS WHICH CAN BE USED TO OBTAIN EITHER D'ARSONVAL OR OUDIN CURRENTS is described in Scientific American Supplement 1618. A plunge battery of six cells, a two-inch spark induction coil, a pair of one-pint Leyden jars, and an inductance coil and all the apparatus required, most of which can be made at home.

SIMPLE WIRELESS TELEGRAPH SYSTEMS are described in Scientific American Supplements 1363 and 1381.

THE LOCATION AND ERECTION OF A 100-MILE WIRELESS TELEGRAPH STATION is clearly explained with the help of diagrams, in Scientific American Supplement 1622.

THE INSTALLATION AND ADJUSTMENT OF A 100-MILE WIRELESS TELEGRAPH OUTFIT, illustrated with diagrams, Scientific American Supplement 1623.

THE MAKING AND THE USING OF A WIRELESS TELEGRAPH TUNING DEVICE, illustrated with diagrams, Scientific American Supplement 1624.

HOW TO MAKE A MAGIC LANTERN, Scientific American Supplement 1546.

THE CONSTRUCTION OF AN EDDY KITE. Scientific American Supplement 1555.

THE DEMAGNETIZATION OF A WATCH is thoroughly described in Scientific American Supplement 1561.

HOW A CALORIC OR HOT AIR ENGINE CAN BE MADE AT HOME is well explained with the help of illustrations, in Scientific American Supplement 1573.

THE MAKING OF A RHEOSTAT is outlined in Scientific American Supplement 1594.

Good articles on SMALL WATER MOTORS are contained in Scientific American Supplement 1494, 1549, and 1495.

HOW AN ELECTRIC OVEN CAN BE MADE is explained in Scientific American Supplement 1472.

THE BUILDING OF A STORAGE BATTERY is described in Scientific American Supplement 1433.

A SEWING-MACHINE MOTOR OF SIMPLE DESIGN is described in Scientific American Supplement 1210.

A WHEATSTONE BRIDGE, Scientific American Supplement 1595.

Good articles on INDUCTION COILS are contained in Scientific American Supplements 1514, 1522, and 1527. Full details are given so that the coils can readily be made by anyone.

HOW TO MAKE A TELEPHONE is described in Scientific American Supplement 966.

A MODEL STEAM ENGINE is thoroughly described in Scientific American Supplement, 1527.

HOW TO MAKE A THERMOSTAT is explained in Scientific American Supplements 1561, 1566, and 1568.

ANEROID BAROMETERS, Scientific American Supplements 1500 and 1554.

A WATER BATH, Scientific American Supplement 1464.

A SMALL LATHE UPON WHICH MUCH VALUABLE WORK CAN BE DONE forms the subject of an article published in Scientific American Supplement 1568.

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attains the level of the break in the meridian. The laws of refraction and total reflection can then be studied by directing luminous pencils toward the center of the globe, in the equatorial plane, and viewing them with the eye placed in the same plane.

In his electroscope (Fig. 4) Chassagny has made use of the fact that platinized glass is sufficiently transparent to allow objects to be seen clearly through it and yet reflects bright images of objects nearer the eye. A vertical and rigid strip of copper and a flexible strip of aluminium foil are suspended from a copper rod and inclosed in a case of which two opposite sides are of glass and the rest of metal. The rod carries a charging disk at its upper end and is insulated by passing through a block of paraffin, which rests on the top of the case. One of the glass sides is platinized, and outside it is placed a graduated quadrant which is seen by reflection, while the deflected strip of aluminium is seen through the glass.

Chassagny's galvanometer (Fig 5) is inclosed in a wooden case which is attached to the wall In a strong magnetic field, formed by placing the like poles of two horizontal horseshoe magnets almost in contact with each other, is suspended a coil of wire of electrolytic copper The intensity of the field is further increased by a soft iron cylinder, supported independently inside the coil A large mirror, attached to the coil, reflects the image of a lamp to a screen, where the movements of the spot of light can be followed by the whole class The galvanometer is provided with three shunts

In Chassagny's apparatus for the study of electromagnetic induction (Fig 6), a coil of wire is attached with its plane vertical, to one end of a lever which can turn round a horizontal axis, and is balanced by a counterpoise on the other end A vertical horseshoe magnet, with its poles directed upward, is placed so that the coil can be brought between the poles or raised above them, by turning the lever on its axis The positive and negative currents produced by these movements are indicated by a galvanometer connected with the coil An alternating current is produced by allowing the lever to oscillate freely Other experiments in induction may be made by sending through the coil a current from a battery

M Chassagny has devised a number of other ingenious instruments, including a very practical rheostat, a eudiometer, a baroscope, etc.

◆

THE LATEST SUBMARINES OF THE UNITED STATES NAVY

(Continued from page 206)

merged condition, certain valves in the interior of the boat are opened This allows the water from the sea to run into great tanks built within the boat and thus virtually sink her These tanks are closely gaged, so that just the required amount of water is taken in Under normal conditions, when the boat is at rest with the ballast tanks filled, she will have a few hundred pounds reserve buoyancy, which is represented by the top of her conning tower protruding above the water If desired, this buoyancy may be entirely destroyed by admitting a small additional amount of water, equal in volume to the volume of that part of the conning tower above water While in the submerged condition, all communication with the outside atmosphere is necessarily cut off The crew, usually about fifteen men, then breathes the air contained in the body of the boat. The amount of air originally contained within the hull is sufficient to support life with comfort for at least twenty-four hours But, in addition to the air thus contained, the boat carries a large supply of compressed air in steel flasks, which, if used for breathing purposes, would be sufficient for a number of days.

After having brought the boat to the submerged condition, in the manner

(Continued on page [illegible].)

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II. CHICAGO AS A RAILROAD CENTER.—Very few Americans realize that Chicago is the greatest railroad center in the world and that it may be likened to a great hub from which radiate the spokes of American transportation

III. THE WONDERFUL GRAIN TRADE OF CHICAGO.—Chicago is an enormous wheat bin, into which much of the grain raised in the middle West is poured. The conveying and handling of that huge amount of grain has necessitated the erecting and constructing of ingenious machinery and elevators

IV SHIPPING ON THE GREAT LAKES.—Most of the iron ore that is now smelted in Pennsylvania is mined in the middle West To transport it to the blast furnaces of the East at a cost which will enable American steel makers to compete with foreign steel makers, it has been necessary to devise a new kind of lake transportation Ships of 10,000 and 12,000 tons burden have been constructed which convey ore at small cost through the Great Lakes, and which are without a counterpart anywhere in the world

V THE HANDLING AND SHIPMENT OF IRON ORE.—The above-mentioned fact that iron ore is mined in the middle West and smelted in the East has necessitated not only the construction of special freight-carrying steamers, but also the designing of special machinery for loading and unloading the ore from the steamers.

VI. FREIGHTING ON THE MISSISSIPPI.—The Mississippi is the great natural waterway of the middle West It places the cities along its banks in direct water-communication with every port in the world That is why freighting on the Mississippi is a more important industry than most of us may realize

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XI. HARVESTING THE GRAIN OF THE MIDDLE WEST.—Farms that cover not acres but square miles, crops that aggregate not simply bushels, but car-loads, have rendered it necessary to plant and harvest on an unprecedented scale in the middle West The ingenious agricultural machinery which has been designed to cope with these peculiar conditions is described and illustrated.

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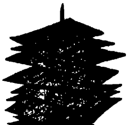

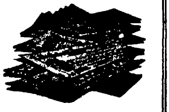

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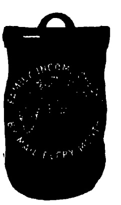

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Speed mechanism, variable, R. E. Rosewarne	936,[illegible]
Spindle, compound, F. Seymour	936,[illegible]
Spool, W. E. Evans	936,[illegible]
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Spring, E. H. Wood	936,971
Spring link, A. R. Day	936,[illegible]
Square, bevel, D. E. Brandt	937,[illegible]
Stacker, hay, L. J. Lindsay	936,[illegible]
Stamp affixing machine, Hotchkiss & Beach, 936,[illegible],	936,[illegible]
Stapling machine, E. T. Greenfield	936,[illegible]

above described, powerful electric motors are started by throwing in a switch. These motors derive their energy from storage batteries contained in the boat, and drive the propellers. The same storage batteries furnish current for numerous auxiliary motors used for pumping, steering, handling torpedoes, etc.

The motion of the boat when under way is controlled by two sets of rudders, one of these sets, known as the vertical rudders, directs the boat's course to port or starboard just as does the rudder of an ordinary ship. In addition, there are provided horizontal rudders, which serve to control the motion of the boat in a horizontal plane; that is to say, the depth at which she runs is regulated by these rudders. For steering in the horizontal plane, instruments are provided so that the boat may be navigated with the same degree of accuracy as boats on the surface. The first of these instruments is known as a periscope. This consists of a vertical tube which extends from above the surface of the water to a few feet within the submarine. At the top of the tube is an object glass, at the bottom an eye-piece. Two reflecting mirrors, one at the top, the other at the bottom of the vertical tube, cause the image to be transferred from the object glass to the eye-piece. The operator can turn the periscope so as to sweep the whole horizon. To the writer, who recently made a five-hour trip in one of our latest boats, the view was as clear as though he were at the surface looking through an ordinary field glass. Hence when running submerged with the top of the periscope just out of the water, the navigator can see with perfect ease surrounding objects. If for any reason it should be desired to run at a still greater depth, compasses are provided by which the course may be steered with accuracy. For steering submerged, in the vertical plane, instruments are provided which in a way take the place of the compass. One of these is a large pressure gage, which indicates the depth at which the boat is running. Another is a form of spirit level, which indicates the inclination of her axis. By the use of this, the man controlling the horizontal rudder is able to run at a perfectly even depth. While in the submerged condition the boat is of course amply illuminated by electric lights. There are no ports or windows in the boat and so far as sensations are concerned, one is unable to determine whether he is running on the surface or submerged.

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While the project of the submarine is comparatively old, it has so happened that but few of them have been used in real war. The first case on record is that of a little hand-power submarine boat built by David Bushnell in 1776. Having obtained permission from the American general in command to use this submarine against the English fleet anchored north of Staten Island, he instructed a sergeant named Ezra Lee in its use. After several attempts, Lee made an attack on one of the ships. His purpose was to fix a torpedo to her side, then go away and allow it to explode, thus destroying the ship. Unfortunately, the ship was sheathed with copper, and he was unable to attach his mine. Lee then drifted away from the ship, having abandoned his mine, which, after drifting about for an hour, exploded, throw-

(Concluded on page 307.)

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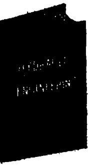

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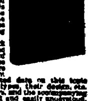

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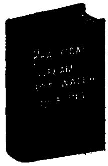

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had up a great volume of water, and thus warning the English of the great danger they had escaped.

Another case on record is that of the Confederate submarine "David," which, during the blockade of Charleston in the civil war, was manned by volunteers, and by hand power was propelled out to the U S. S. "Housatonic," which she destroyed by the explosion of a mine in contact with her hull.

During the Spanish-American war the modern submarine had not made its appearance. During the Russian-Japanese war both sides ordered boats, but the war was finished before these vessels became available. At present all the leading naval powers are acquiring submarines in large numbers, so that during the next war we may expect to see them figure largely in the various operations.

In the trip in a submarine above referred to the Editor was impressed with the smoothness and accuracy with which the submarine went through her submerged evolutions. The movements, quick response, etc., of the boat were such as to inspire complete confidence in her stability and general efficiency

There can be no question that the submarine has at last "come into its own" Among the captains of the battleships and the line officers in general at Provincetown, there was noticeable a growing respect for these craft, due to the varied and accurate work which the flotilla had accomplished during the summer maneuvers. There has been a steady but slow growth in the speed of the submarine. Its control is now perfect, and its radius of action is being rapidly increased Our largest boats have a radius of about one thousand miles and two are under construction on the Pacific coast which will have a cruising radius of about three thousand miles. This means that the submarine is taking on full seagoing qualities It must no longer be regarded as restricted to seacoast operation The time is not far distant when an admiral searching for the enemy upon the high seas may include a submarine flotilla in his fleet. The profound significance of this fact upon strategy and tactics will be appreciated by every naval expert.

◆

In his study of living beings, the physiologist has one guiding principle which plays but little part in the sciences of the chemist and physicist, namely, the principle of adaptation. Adaptation or purposiveness is the leading characteristic of every one of the functions to which we devote in our text-books the chapters dealing with assimilation respiration, movement, growth, reproduction, and even death itself. Spencer has defined life as "the continuous adjustment of internal relations to external relations." Every phase of activity in a living being is a sequence of some antecedent change in its environment, and is so adapted to this change as to tend to its neutralisation and so to the survival of the organism. This is what is meant by adaptation. It will be seen that not only does it involve the teleological conception that every normal activity must be for the good of the organism, but also that it must apply to all the relations of living beings. It must therefore be the guiding principle, not only in physiology, with its special pre-occupation with the internal relations of the parts of the organism, but also in the other branches of biology, which treat of the relations of the living animal to its environment and of the factors which determine its survival in the struggle for existence. Adaptation therefore must be the deciding factor in the origin of species and in the succession of the different forms of life upon this earth.

◆

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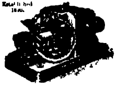

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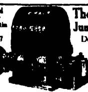

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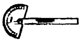

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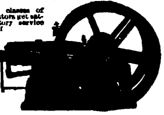

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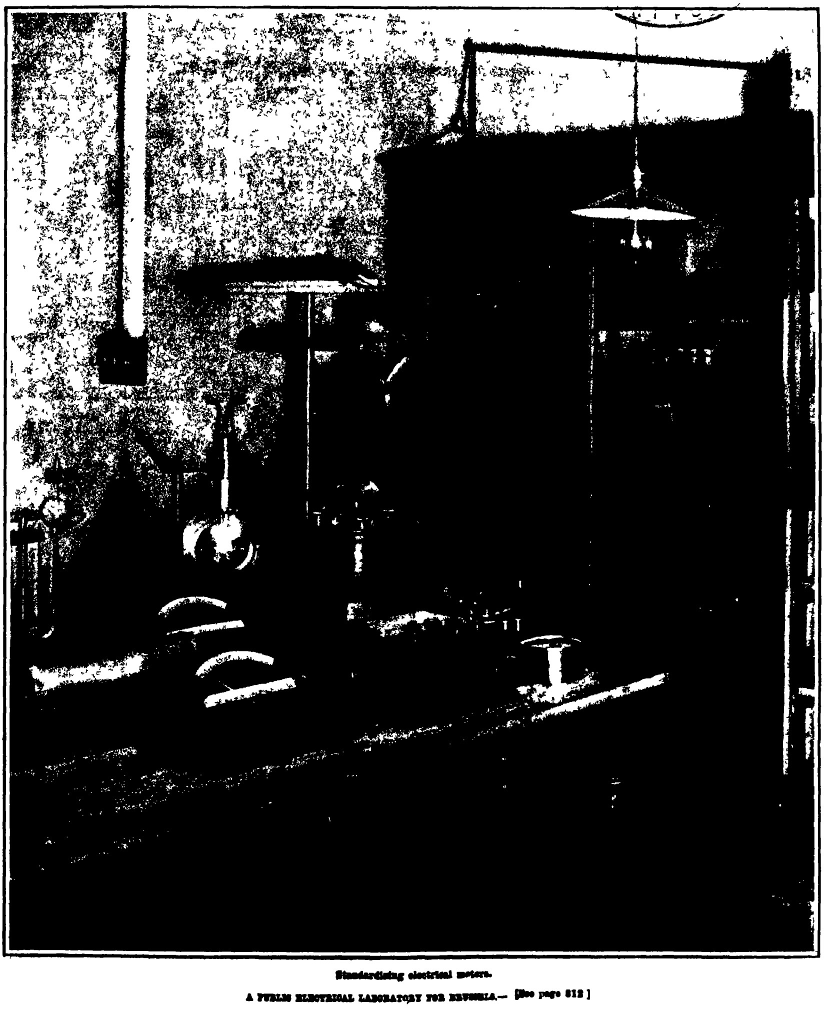

Standardizing electrical meters.

A PUBLIC ELECTRICAL LABORATORY FOR BRUSSELS.—[See page 312.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, OCTOBER 30th, 1909

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

SLAG A CAUSE OF BROKEN RAILS

The scientific investigation of the cause of broken rails has a strong claim on popular interest and this for the reasons that we all are more or less frequent travelers by rail and that the breakage of rails is one of the most fruitful causes of serious railroad accidents. The agitation of three years ago which followed upon the publication by the State authorities of statistics showing an alarming increase in the number of broken rails has been productive of excellent results. It has served to bring together the rail manufacturer and the railroad engineer in a joint endeavor to determine more exactly the causes of rail failure and devise improvements in the methods of manufacture which will give a thoroughly reliable rail without entailing an undue amount of extra cost in the making.

During these intervening three years a most exhaustive chemical and mechanical investigation of the subject has been made and many hitherto obscure and little-understood facts have been brought to light regarding the mechanical condition and chemical composition of faulty rails, the causes which have produced these conditions, and the best methods of casting and working to produce a rail which will stand up under its work without betraying that alarming liability to sudden fracture which has caused so much loss of life and property during the past few years.

One of the latest papers on the subject was that presented by Messrs. Fay and Wint at the annual meeting of the American Society for Testing Materials, in which attention was drawn to the frequency with which rail breakages may be traced to the presence of slag. The investigation by these gentlemen of rails that had broken in the head shows the presence of excessive slag, a segregation of slag concentric with the rail section, remnants of slag in the large split portion of the head, and slag in those areas where flow of metal has occurred or where microscopic cracks have developed. While it is impossible from the evidence so obtained to state definitely the exact cause of fracture, it is highly probable that it is due to imperfectly welded blowholes or pipes. The investigation showed that at the point of fracture there is always to be found a large amount of slag, that cracks invariably begin in and follow from one slag area to another, and that cracks within the body of the metal produced by shrinkage strains will follow along the slag areas. Thomas Andrews, in his paper entitled "Microscopic Internal Flaws Inducing Fracture in Steel," considers it to be a most significant fact that in the various material he examined, almost without exception, there was a considerable slag area, in or near the fractured surface, and he says that the internal microscopic flaws which are almost invariably present in steel forgings constitute a chief source of initial weakness in axles, rails, shafts, heavy guns, etc.

The hard spots which have been observed in broken rails are apparently due either to imperfect mixing and solution of the ferro-manganese or to the hardening of the surface of the metal due to slipping of the driving wheels, or to segregation in steel alloys. The first and second causes are not common, but the third, which is due to the imperfect melting of the alloy, is more serious. An examination of several nickel steel rails which had broken in service showed streaks of very hard, medium hard, and soft metal, and it is the belief of the authors of the paper that this lack of uniformity is due to segregation of the nickel during the cooling of the ingot. It is suggested that the various defects above mentioned could be remedied, first, by using a specification asking for lower sulphur, secondly, by allowing more time between the addition of ferro-manganese to the hot metal in the ladle and the pouring of the metal into the ingot mold, and thirdly, by pouring the metal from the bottom of the ladle. Finally, although Messrs. Fay and Wint believe that electric refining will remove many of the difficulties attendant upon the present method, it must not be assumed that this would prove to be a panacea, since without competent control bad steel can be produced just as easily in an electric furnace as by any other method.

OUR VANISHING TIMBER SUPPLY

When the adventurous navigators of three or four centuries ago skirted the coasts and entered the bays and rivers of this country, they were impressed with the extent and variety of the forests which everywhere spread their rich mantle over the country. And well they might be, for the original forests of the United States exceeded in the quantity and variety of their timber the forests of any other region of similar size on the globe. Nature was lavish when she laid out and planted the five great forests of this country, and lavish she was when she planned its noble watercourses, smoothed out the vast arable lands of its prairies and wide-spreading valleys, and stored below the surface its priceless wealth of iron ore, coal, oil and precious minerals. Where Nature had been so prodigal of her supplies it was perhaps inevitable that man should become equally prodigal in their use, and no doubt the extravagance and wastefulness which have become a national characteristic, are due largely to natural environment.

Of all the natural resources of the country, our forests have been one of the worst, if not the worst sufferers from extravagance, and this is proved by the simple fact that we use (or waste) ten times as much timber per capita as they do in France, and are, consequently, cutting our forests three times as fast as they are growing. The original forests of the United States included five great forest types. The Northern forest reached from Maine through New England, New York and Pennsylvania, to Georgia, and through central and northern Michigan and Wisconsin to Minnesota, and covered about 150,000,000 acres, mainly of cone-bearing trees. The Southern forest commenced in New Jersey, and reached from the coast far inland through Virginia, the Carolinas, Georgia, Florida, Alabama, Mississippi and Louisiana, and portions of Texas, Oklahoma, and Arkansas. This is the great belt of the yellow pine. Its total original area was about 220,000,000 acres. The Central forest, which extended between the northern and southern forests from the Atlantic coast to the western prairies, is the great source of our supply of hard woods. Originally it included not less than 280,000,000 acres. Then to the westward was the Rocky Mountain forest, extending from Montana and Idaho to New Mexico. Here on the high plateaus and mountain slopes is a growth of coniferous trees, including western yellow pine, Douglas fir, larch, spruce and cedar. Its original extent was at least 110,000,000 acres. Lastly, and the grandest of all, was the Pacific coast forest, extending through Washington, Oregon, and California, whose original area of at least 90,000,000 acres was covered with the most majestic growth of coniferous trees in the world.

Much has been said and written of late about the destruction of our forests, and one of the latest and most illuminating pamphlets on the subject is that by R. S. Kellogg, Assistant Forester in the Forest Service of the Department of Agriculture, who tells us that, whereas, at a conservative estimate, these five great forests of the United States covered originally 850,000,000 acres and contained 5,200 billion feet of timber, at the present time their total area has been reduced to 550,000,000 acres, containing less than one-half as much standing timber than they did in their virgin state.

The total yearly drain upon our forests, not counting losses from fire, storms, and insects, is estimated to be about 20,000,000,000 cubic feet. Of our present forest area of 550,000,000 acres, 200,000,000 acres are roughly estimated to consist of mature forests, in which the annual growth is balanced by death and decay, and 250,000,000 acres consist of timber partially cut or burned over, on which with reasonable care there is sufficient young growth to produce ultimately a merchantable, but not a full crop of timber. The remaining 100,000,000 acres consists of forests so completely cut out and burned, that there is not sufficient young growth to produce another crop of much value. According to this estimate, the annual growth of all our forests is not over twelve cubic feet per acre, or a total of less than seven billion cubic feet. Since we cut yearly some twenty billion cubic feet over and above what is lost by fire and other natural causes, it follows that we are cutting out our forests three times as fast as they are grown. Just how unreasonably extravagant this country has been in using up its timber supply, is shown by comparison with the conduct of Germany and France. In Germany 37 cubic feet of timber per capita are taken annually from her forests, France is able to get along with but 25 cubic feet; while in this country the consumption is 250 cubic feet per capita. Germany, furthermore, has applied her scientific methods with such good effect, that her state forests are producing to-day an annual average of 48 cubic feet of wood per acre.

It is considered that the demand for more farm land may eventually lead to a further encroachment to the extent of 100,000,000 acres upon our present forests, reducing the total to 450,000,000 acres. The Forest Service considers, however, that it would be entirely possible, if the forest land is improved and the timber economically cut and completely utilized, to produce on the remaining 450,000,000 acres sufficient wood for a population much greater than we now have in the United States.

DEATH OF PROF. LOMBROSO

Cesare Lombroso, certainly the most widely known if not the most authoritative criminologist of our day, died on October 19th, 1909, at Turin, Italy, at the age of sixty-four. If Lombroso had never written anything else than his "Criminal Man," his name would be handed down in the annals of psychology. Even though in his later years he was given, without careful investigation, to rather hastily fitting into his theory any newspaper story or fact that might have met his eye, it must be stated that his contributions to criminal anthropology are valuable and lasting. His theory that criminals must be regarded as mentally diseased persons, although not yet legally accepted by society as a whole, nevertheless finds favor with a large number of psychologists. No doubt his system of criminology is not so far developed that we are justified in abolishing prisons and treating criminals in insane asylums as Lombroso advocated, but at least it tends toward a scientific solution of the problems presented by crime and its punishment.

It was while he held the post of army surgeon that Lombroso's attention was first drawn to malformations of the skull. An executed murderer's cranium was so markedly malformed, that he was induced to make an investigation to ascertain whether or not the man's crime might not have been occasioned by his cranial defects. The rest of Lombroso's life was spent in piling facts upon that original fact. As a lecturer on psychology at the University of Pavia he later had abundant opportunity for studying inmates of the insane asylum there, and was impressed with the connection between nutrition and sanity. As a result of that study, he showed that a poor quality of maize was responsible for much of the pelagra from which Italian peasants were suffering. After a hard campaign he succeeded in inducing the authorities to take measures to reduce the disease. Lombroso's researches were extended also to the study of epilepsy and genius. His theory that genius was a form of insanity was widely heralded, and attracted not a little comment, both hostile and favorable.

Recently Lombroso devoted much time to the study of spiritistic phenomena. He made an elaborate study of Eusapia Paladino and was won over by her to a partial belief in the physical manifestation of spiritualism, yet he was never quite willing to accept spiritualism in the sense of preservation of personal identity after death.

COUNT DE LAMBERT'S FLIGHT OVER THE EIFFEL TOWER.

The most sensational flight ever made in an aeroplane was that accomplished by Count de Lambert with his Wright biplane on October 18th, when he flew from the aerodrome at Juvisy, where an aviation meeting was in progress, to Paris and back, covering a distance of about 30 miles in 49 minutes and 39 seconds. After making two circuits of the aerodrome, Count de Lambert headed for Paris, and, continually rising, soon disappeared from view. He flew over Paris at a great elevation, and by the time the Eiffel Tower was reached, he had risen sufficiently to clear it nicely. He passed directly over the tower, which is 984 feet in height, turned his machine around, and headed back for Juvisy. He arrived and landed safely, and was greeted by Orville Wright, who had just arrived from Berlin after making a special flight for Emperor William—the first aeroplane flight the German Emperor had ever witnessed—a few days before. While in Germany, Orville Wright also made a record height flight, in which he reached an elevation of about 1,600 feet, as near as he could estimate. Count de Lambert's height was visibly demonstrated by his passing over the Eiffel Tower. At a height of 1,600 feet the principal sensation he experienced was that his aeroplane appeared to be scarcely moving. The time, he said, seemed interminable ere he finally reached his starting point. His average speed was about 37 miles an hour.

ENGINEERING

Work on the last section of the Jungfrau railway has progressed so well during the recent summer, that it will probably be opened next year from Eismeer to Jungfrau Joch. A station at the former place has been hewn out of the solid rock at an altitude of 3 153 meters, capable of accommodating 200 persons.

Buenos Ayres, the name of which suggests palm trees and sunshine and the transaction of business with sub-tropical leisurely haste, is getting sufficiently busy to demand subways. A bill is pending in the Argentine Legislature to authorize the construction of underground electric railways operating in connection with existing surface lines.

The Wolseley Motor Car Company, leading makers of "all-British" automobiles, are giving special attention to aeroplane engines and have delivered several V-type 50-horse-power machines to intending aviators. These motors, although they weigh only 300 pounds, are claimed to be capable of delivering as high as 75 horse-power One of them was recently installed in a new Voisin biplane.

The Austrian government appears to be divided upon the "Dreadnought" question, the proposed expenditure upon naval construction for next year having been reduced by $5,000 000 A torpedo cruiser named "Admiral Spaun will be launched about the end of this month, the first ship of the Austrian navy to be equipped with Parsons turbines, with an estimated speed of 26 knots.

It appears that the Siberian railroad is beginning to show the inevitable results of the haste and cheapness with which it was constructed The sharp curves and heavy grading have put serious limitations upon traffic, and for great distances the reconstruction will involve an entirely new location The road is to be changed from single to double track and the officials are greatly regretting that the large and costly bridges were built to accommodate one track only On the level plains the double tracking will not be such a serious matter but in the heavy cuts of the mountain division, and where the steel bridges over the wide rivers will have to be rebuilt, the cost will be very high

The rapid advance of aviation to the dignity of a science is indicated by the fact that the University of London has arranged for a special course on aeronautics to be conducted by Mr A. P Thurston one of Sir Hiram Maxim's engineers It will consist of a series of lectures followed by drawing office practice in the design and construction of aeroplanes The syllabus of the lectures is as follows (1) The normal and inclined plane (2) Stream line surfaces, center of pressure and resistance of bodies (3) The propeller and helicopter (4) Calculations applied to a flying machine. (5) The biplane. (6) The monoplane (7) Aeronautical engines (8) Automatic stability and control (9) Dirigible balloons

During the past season the old, deep-keel, narrow beam English cutter 'Bloodhound' has been scoring some remarkable wins in races against cutters of the most modern design, Commenting on her performances, the Yachtsman of London says that opinion has been expressed that many present-day designers do not know their business and adds 'Speaking for ourselves, we say without hesitation that they do not It is not by any means our purpose to eulogize the performances of the Bloodhound' unduly, but we repeat that there is something wonderful in the fact that a yacht so antiquated in shape was able to beat two modern cruisers of fifty per cent over her tonnage" Of course, the feat was performed in strong winds and under reduced canvas. It is in light weather that the modern yacht is so greatly the superior to the older craft.

Tests have recently been concluded by Messrs Burstall and Monkhouse, of London, of a portable combined boiler and engine, the economy and efficiency of which are so remarkable that we shall hope to describe the tests more in detail either in the SCIENTIFIC AMERICAN or SUPPLEMENT in the near future, limitations of space preventing their adequate discussion at present. The engine is a so-called "locomobile," built by the Wolf Engineering Works of Magdeburg Buckau, but it must not be confounded with the automobile of that name, as it is not strictly an automobile engine. It consists of a locomotive type boiler, from which the steam is conducted through a superheater in the smokebox directly to the high-pressure cylinder of the engine, which is tandem compound and mounted directly on the boiler under the same jacket, so that the cylinders are surrounded by the flue gases. Such is the heat economy effected by this arrangement, that this commercially constructed "stock" engine and boiler, adaptable to threshing, plowing, sawing, or any of the ordinary work of a portable engine, develops 1 brake horsepower with 1.66 pound of coal and 8.81 pounds of water The efficiency is very little reduced by running the engine with 25 per cent above its economical load or 25 per cent below.

ELECTRICITY

A contract has just been given by the Brazilian government to a French telegraph company to erect a wireless telegraph station on a small island 200 miles off the coast of Rio Grande do Norte the easternmost point of South America. The island is 400 miles from Pernambuco The station will have an operating radius of 1,000 miles. It will be connected by an auxiliary station at Pernambuco with the Brazilian telegraph system.

The city of Baltimore has adopted an ordinance which requires the testing of every electric meter by the Department of Lamps and Lighting, before the meter may be installed A charge of ten cents is made for each inspection Any consumer who is suspicious of his meter may have it examined by the department. A charge of $1 is made for this service, which is borne by the consumer if the meter is registering properly or by the company if the meter is found to be at fault.

The recent announcement of the British Welsbach Company that it has entered the electrical field and is manufacturing metallic-filament electric lamps, has caused quite a stir in England. Many look upon this news as a blow to the gas business Welsbach mantles have heretofore made it possible for gas to compete with electricity as an illuminant but the fact that the Welsbach Company is taking up the manufacture of electric lamps would seem to indicate that the gas mantle cannot compete with the metallic filament lamp

Electric railways frequently require an extra supply of power owing to a holiday rush or some unusual event which crowds their cars to the utmost capacity Some of the roads have built their own portable substations consisting of cars provided with rotary converters or motor generators transformers and switchboards Recently one of the large electric manufacturing concerns has put out a stock portable substation of this type which may be moved to any section of the line and made ready for use at a moment's notice by connecting it to the high tension line

The annual Electrical Show at Madison Square Garden which was brought to a close last week was notable for its decorations. Nearly 40 000 yards of orange and white bunting were used to decorate the building The whole interior of the building was draped with bunting There was a canopy ceiling which was divided into panels, and candelabra were hung from the intersections of the panels Each candelabrum contained a cluster of twenty two 25 watt tungsten lamps encircled with amber-colored 40-watt lamps Six large chandeliers were placed over the center of the arena. These chandeliers were ten feet in diameter made up of art glass. Altogether the effect was superior to that of any previous exhibition

At the recent meeting of the International Association of Municipal Electricians a resolution was adopted favoring the grounding of secondaries in alternating-current systems The resolution calls attention to the fact that life and property have been destroyed from high voltages on alternating-current secondary systems, because of the failure of insulation between primary and secondary circuits, and that such dangers may be obviated by grounding the secondary and it demands the enactment of legislation requiring all alternating-current secondary systems to be grounded when by so doing the voltage between the earth and any part of the secondary systems will not exceed 250 volts.

A German investigator has found that the insulation resistance of coils made from bare aluminium wire depends upon the compression of the wire and also on its thickness The smaller the wire the less its insulation resistance This he thinks is due to the fact that the thick wires are soft, while thin wires are hard drawn He also finds that the resistance is considerably reduced while the coils are wet. He therefore suggests that in making coils of bare aluminium wire, the windings should be separated by non hygroscopic material Before winding the coils they should be wet so as to oxidize the aluminium After several days they should be dried in a vacuum and lacquered

The following method of impregnating field coils was recommended at the recent convention of the American Street and Interurban Engineering Association The wire is insulated with asbestos held in place by a cotton covering The coil is wrapped with porous tape, and then placed in an air-tight chamber and heated. The air in the kettle is exhausted and when the proper vacuum has been obtained melted asphaltum is permitted to flow in after which air pressure is applied, forcing the material into the interstices of the coil. When the coil is nearly cool it is brought to proper shape by means of clamping plates. When the clamps and tape are removed, the coil is covered with an insulation of varnished cambric.

SCIENCE.

Evelyn Briggs Baldwin, the Arctic explorer recently stated that he intended to make another trip to the Arctic and go on the ice drift over the apex of the earth and return between the east coast of Greenland and the west coast of Spitzbergen. It is a distance of two thousand miles and as a progress of no more than two miles a day can be made the journey will consume four years

Certain minerals exhibit the curious optical property known as asterism That is to say they show a star shaped figure when light is reflected from them or transmitted through them This is seen, for example, in the star stone a sort of sapphire and in the star ruby A note in Knowledge describes the asterism of mica. The photograph of a lamp flame taken through a plate of mica shows a six rayed star with six fainter radiations between Outwardly star mica resembles the ordinary form and shows the same phenomena under polarized light When examined under the microscope however the star mica is found to contain fine needles of another mineral and these are regularly arranged at angles of 120 deg To these needles the star seen by transmitted light is due Star mica has been found in the State of New York and at Burgess Hill Ontario

Henry Gannett, chairman of the United States Geographic Board Rear Admiral Colby M Chester U. S N formerly superintendent of the Naval Observatory, and O H Tittmann superintendent of the United States Coast and Geodetic Survey will compose the membership of the committee of the National Geographical Society which will pass on the records and proofs submitted by Robert E Peary to substantiate his claim that he reached the North Pole on April 6th 1909 At a meeting of the board of managers of the National Geographical Society on October 20th the records and observations furnished by Commander Peary were presented and Mr Gannett who had previously been appointed chairman of the committee on polar research named Admiral Chester and Mr Tittmann as the other members of the committee to determine Commander Peary's claims

In order to produce a cadmium spectrum of sufficient intensity for polarimetric work advantage is taken of the favorable properties of the silver-cadmium alloys by Dr T Martin Lowry On account of their isomorphism the two metals form an excellent series of alloys which are characterized by good mechanical properties and very high melting points. (An alloy with 60 per cent Cd melts as high as 700 deg C) In striking contrast to the behavior of the pure metal the alloy gives a steady arc which can be kept true to center by rotating the electrodes in opposite directions The spectrum shows the silver as well as the cadmium lines but these are so far separated that even with a low resolving power the slit of a spectroscope can be opened to its full width without any overlapping of the brilliant blocks of light which take the place of the usual lines

Arrangements are being perfected in New York for the incorporation of the American Radium Institute to be devoted to the treatment of cancer and similar diseases The Institute will be conducted much on the same plan as similar ones in Paris and London The work will be divided into various sections such as chemical physical medical and botanical with an expert in charge and it is believed that for experiments the laboratories of the Rockefeller Institute will be available Supplies of pitchblende for manufacture are to be drawn from Colorado and other Western localities where the initial processes of extracting the radium will be conducted It is announced that the institute is not in any sense commercial and that several of the scientists who are interested in it are not only giving their services free but are contributing from their own means to the fund which will be required to establish the plant

The observatory of Treptow has opened an international competition for the best photographs of the Leonid meteors taken from the car of a balloon between November 13th and November 16th 1909 The developed plates should be sent to the observatory anonymously but accompanied by a symbol which is repeated in a sealed envelope containing the place date and hour of exposure, the name and elevation of the balloon names of constellations in which meteors have been observed names of camera and lens with focal length and aperture, and the length of exposure The plates should reach the director of the observatory Dr F S Archenhold before January 1st 1910 The results of the competition will be published in the journal Das Weltall Three prizes consisting of a telescope and publications, are offered, but it is stipulated that the prize pictures shall become the property of the observatory The competition would have a better prospect of success if all photographs of the Leonids had been admitted. Balloons are still so rare that it is quite possible that not a single plate will be submitted

THE BRUSSELS POPULAR ELECTRICAL LABORATORY

BY DR ALFRED GRADENWITZ

Owing to the ever increasing importance of the applications of electricity it is small wonder that electrical laboratories should have been founded everywhere to afford a means of completing practical instruction In fact technical colleges and schools of all degrees are at present equipped with such laboratories

However the institute recently founded at Brussels by Dr Robert Goldschmidt the well known inventor and scientist is of an absolutely novel kind Realizing the inadequacy of book study and oral explanation for conveying a thorough understanding of experimental electricity Dr Goldschmidt provides an opportunity for experiment accessible to the general public desirous of observing the electrical phenomena which are so important for modern industry To attain this end he has created a popular laboratory of remarkably clear and simple disposition where lay people by starting from the most elementary facts will be able to acquaint themselves with any scientific problems relating to electricity

The original intention was to create some sort of museum of electrical invention and discovery organized on similar lines to the general museums of painting natural history and industry This however would have been quite insufficient as the object of any piece of apparatus exhibited would rarely be immediately apparent to the observer What was to be shown was not the principle itself but its demonstration and the method of conducting an experiment to demonstrate it and the best means of teaching the student this is to let him conduct the experiment himself This task was an extremely difficult one entailing as it did a rational classification of experiments such as should render them comprehensible In fact the main defect of any previous attempts in the same direction (made at London Berlin and Munich) had been the lack of plan and co-ordination

Every experiment had to be designed with a view to its being accessible to everybody in addition to forming part of a graduated course of inter-connected experiments Most of the apparatus used in connection with the Popular Laboratory had to be designed and constructed especially for the purpose and with a view to simplicity safety and solidity

On the ground floor of the laboratory (which was opened on the occasion of the recent twenty fifth anniversary of the foundation of the Society of Belgian Electricians) are installed apparatus for the fundamental experiments constituting the basis of modern electrical science These are performed with relatively simple means Visitors thus pass from the magnet stone to the properties of electro-magnets and the explanation of electro-motors from the generation of static electricity by the friction of glass and wax on to the working of Wimshurst machines on similar principles and to induction coils they then proceed to familiarize themselves with the phenomena of electrical discharge in various media (cathode and radium rays etc)

In the gallery are installed those apparatus which are required for the demonstration of the principles of electrical induction alternate currents and methods of electrical measurement

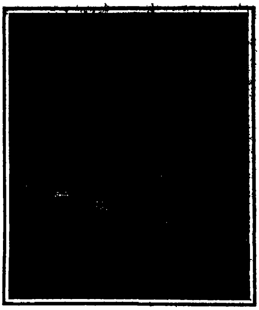
Each apparatus installed in these two departments of the laboratory is located in a glass case leaving free to the experimenter's hands only the instrument required for performing the experiment and thus avoiding any unnecessary contact liable to endanger the apparatus In three adjoining rooms are united the apparatus of precision and investigation as well as measuring instruments the handling of which requires a thorough knowledge of all the preceding comprising photometers precision bridges standards of measurement galvanometers wattmeters etc

On the ground floor in the center of the building are found such apparatus as will allow the visitor to familiarize himself with the most important measurements relating to motors and dynamos These two departments are different in character from the two preceding In fact visitors here find themselves in a laboratory where measurements and tests are performed by competent men By watching their work they will be able to grasp the mechanism of the experiment without being capable of performing it themselves Should however somebody sufficiently well instructed wish to experiment himself he would be allowed to do so under the supervision of an experienced operator

To the laboratory is connected a lecture hall behind which is installed a projector allowing visitors at any moment to inspect on the screen an extensive series of hundreds of views relating to scientific novelties This is actuated by a push button

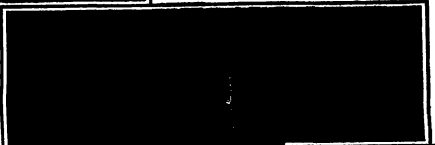
A special hall is set apart for industrial men to exhibit their products free of charge and a library containing the most important books periodicals and bibliographical files enables visitors to supplement by theoretical study the practical knowledge acquired in the laboratory

A mechanical workshop initiates those seeking such information in the construction of electrical apparatus Finally four small laboratories situated in the front building are to be placed at the disposal of specialists for use in original research work

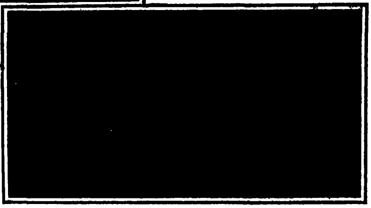


Apparatus for demonstrating current effects.

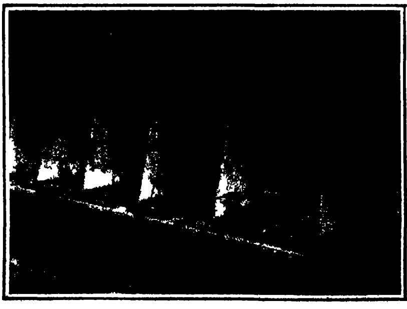
A row of static electrical machines



Apparatus for the study of natural and permanent magnets and terrestrial magnetism.



Apparatus for the study of radiation phenomena.



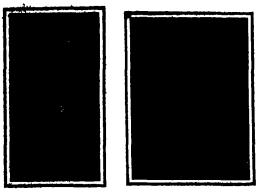
Apparatus for demonstrating attraction and repulsion of charged conductors.

Electrical measurement apparatus.

THE BRUSSELS POPULAR ELECTRICAL LABORATORY

A CURIOUS CHEMICAL GROWTH.

In the course of some experiments in qualitative analysis in the High School at Medford, Mass, a test tube containing solutions of several salts to which had been added hydrochloric acid and ammonium sulphite was set away in a closet for a few days Projecting vertically from the tube was a small piece of filter paper When the tube was removed a peculiar calash-shaped hood of ammonium chloride crystals was found resting on the paper


CURIOUS CHEMICAL GROWTH.

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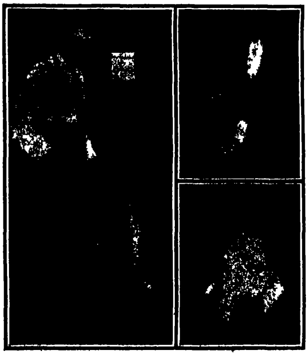
PLAYING WITH FIRE

A can of gasoline can be handled as safely as a can of oil for liquid gasoline does not explode It is the gasoline vapor that is highly explosive when properly mixed with air The accompanying illustrations show the safety with which burning gasoline may be handled Fig 1 shows a man pouring burning gasoline from one can into another In Fig 2 he is blowing into the spout of a can of gasoline to which a match has been applied The little blue flame that ordinarily plays around the mouth of the can is transformed into a burning torch Fig 3 shows a pool of burning gasoline on the floor and two gasoline cans aflame, but there is no explosion


PLAYING WITH FIRE

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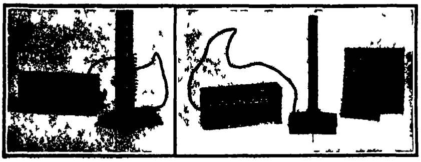
MEASURING HOLES BY ELECTRICITY

One of the employees of a Chicago firm dealing in perforated metal to be used in flour mills has devised a simple measuring device for readily matching samples brought in by customers A tapering needle which is pushed into one of the perforations as far as it will go carries a brush that passes a series of electric contact pieces The latter are connected to a set of solenoids and when the circuit is closed by pressing a button one of these solenoids operates to uncover a number indicating the correct size of the hole


MEASURING HOLES BY ELECTRICITY

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DIFFERENTIAL SPEED INDICATOR

The well known British naval architect Sir John I Thornycroft has designed an ingenious device for use on twin screw torpedo boats to indicate the relative speeds of the two propeller shafts A sphere is supported on and rotated by two cylinders whose axes meet at a point below the sphere The axis of rotation of the sphere varies its position with the relative speed of rotation of the cylinders A roller engaging the sphere tends to find a position where it does not slide In other words the axis of the roller moves into the plane of the axis of the sphere and a finger connected to the roller indicates the position of the axis of the sphere and thereby shows the difference of speed of the two shafts

DIFFERENTIAL SPEED INDICATOR.

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Measurement of Distance by Aerial Electric and Sound Waves.

Debrix has invented a method of measuring a ship's distance from a shore station by taking advantage of the difference between the velocities of sound and electric waves A bell is set ringing and wireless electric waves are generated simultaneously on the ship The electric waves arrive almost instantaneously at the shore station and there set in motion a stop-clock The distance of the ship can be computed from the number of seconds indicated on the dial when the sound of the bell is first heard The computation is facilitated by the use of a table in which if necessary allowance may be made for the fraction of a second consumed in the operation of the receiving and clock starting apparatus In this way the distance of the ship can be obtained but not its direction or exact position If however the ship's auditory and electric signals are simultaneously received at two stations connected by telegraph the exact position of the ship on the chart will be found at the intersection of two circles drawn round the stations as centers with radii respectively equal to the ship's ascertained distances from those stations The general introduction of this system would greatly increase the possibility of aiding ships in distress—Prometheus

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ACCIDENT PREVENTER

MOTORISTS ACCIDENT PREVENTER.

Attached to the wall at the corner of a narrow street leading in to the market place of Woodbridge Suffolk County England is a mirror which makes it possible for automobilists coming from either direction to look around the corner and thus avoid collisions The idea is being copied quite extensively by other English towns

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Castings of Chloride of Zinc

By mixing a concentrated solution of chloride of zinc which must be of at least [illegible] deg Bé with highly heated zinc oxide we obtain a mass that is admirably adapted for the casting of various art objects

This preparation is at least equal in hardness to marble and takes a high polish as regards its behavior to exterior influence it excels marble altogether in its power of resistance being unaffected by the action of severe cold moisture or even boiling water and it is also fairly indifferent to the effects of very strong acids

This excellent casting mass is best produced by taking [illegible] parts of zinc white which has been highly heated (calcined) and after cooling kept in air tight glass vessels until needed and mixing it with 1 part of chloride of zinc solution of 55 deg Bé To effect the mixture we use a porcelain vessel in which we place first the zinc oxide then pour in the chloride of zinc solution and by stirring with a flat spatula produce a uniform mixture In mixing great care must be taken that no air bubbles occur in the mass for these would give rise to imperfect or defective castings The well stirred mixture is allowed to stand until it begins to become more fluid and it is then poured into molds in which it is permitted to harden If the zinc oxide before using is mixed with ground glass or with colors that exercise no chemical effect on zinc oxide (English red manganese chrome green red lead) colored castings can be produced

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A SURVEYOR'S TELEPHOTO

The view herewith reproduced was photographed at a distance of a mile with a surveyor's level set up in front of a 4 by [illegible] camera The two instruments were connected light tight by winding a dark cloth around the contiguous parts An exposure of twenty seconds was made as the weather was cloudy It is somewhat surprising that no trace of the cross wires of the telescope appear on the picture

A SURVEYOR'S TELEPHOTO.

HIGH-SPEED DESTROYERS FOR THE UNITED STATES NAVY.

There was a time when the contractors of the United States seemed to be unable to live up to the exacting requirements of the government for the construction of torpedo boats and destroyers. There is no class of naval construction that calls for such high-class work as the building and equipment of a destroyer of 30 knots speed or more, and when our first destroyers were built most of the contractors failed to get the contract speed out of the boats

These failures however belong to the past and there is every reason to believe that the later destroyers built for our navy are fully up to, if they do not exceed the standard of the best foreign work, not even excepting the British

Evidence of this is afforded by the phenomenal speeds that have been realized in the recent trials of the 'Flusser and the 'Reid,' which made respectively 30.41 and 31.85 knots as the mean of a four hour trial the contract speed for which was only 28 knots and made their fastest miles respectively at a speed of 33.67 and 34.55 knots

The 'Flusser' and Reid' are two of the five destroyers bids for which were opened in September 1907 and which were awarded as follows The "Flusser and Reid' to the Bath Iron Works, Ltd Bath Me the 'Smith' and Lamson to the William Cramp & Sons Ship and Engine Building Company, Philadelphia Pa, and the "Preston to the New York Shipbuilding Company of Camden N J

Copyright 1909 by N L. Stebbins.

Length, 293 feet 10¼ inches, beam, 26 feet 4½ inches; draft, 8 feet displacement 700 tons, horse-power 15,140. The motive power consists of five Parsons turbines driving three propellers. The "Flusser" (sister boat) on her trials reached a maximum speed for one mile of 33.67 knots.

THE "REID," FASTEST OF OUR DESTROYERS, MAKING 34.55 KNOTS ON HER TRIAL TRIP

The hulls of the Flusser" and Reid" were designed by the Bureau of Construction and Repair and are of the following dimensions

Length between perpendiculars	289 feet
Length over all	293 feet 10¼ inches
Breadth molded at trial waterline	25 feet '1¼ inches
Breadth molded extreme	26 feet 4½ inches
Breadth extreme over guards	27 feet
Trial displacement	700 tons
Trial draft at this displacement	8 feet ½ inch

The contract allowance for machinery is 255 tons a penalty being assessed if this weight is exceeded The machinery however with water and spares carried on board weighed 228 tons so that the trial displacement was reduced by this saving of 27 tons less a hull overweight of 4 tons or a net weight saved of 23 tons The trial displacement therefore was fixed at 677 tons but on all of the trials of these vessels they were slightly deeper than this

The machinery was designed by the Bath Iron Works and consists of five Parsons marine steam turbines on three shafts the main high pressure being on the center shaft the starboard low pressure and I P cruising turbines together with the starboard backing turbine being on the starboard shaft and the port low pressure and backing turbine and the high pressure cruising turbine being on the port shaft The steam piping was so arranged that any of these turbines would run as the initial turbine All of these turbines are in one compartment

The two condensers were built up of plate each containing 4,000 square feet of cooling surface, measured on the outside of the tubes. The tubes were curved and expanded into the tube sheets, no packing being used The circulating water is provided by scoops into which the sea water rushes at great velocity when the vessel is under way, this method proving extremely satisfactory Small circulating pumps, however, were provided for use when the vessel is still in the water, or in getting under way There are the usual air pumps, feed pumps fire and bilge pumps, and oil pumps, etc, and an evaporating distilling apparatus was also provided with these pumps. All lubrication is forced, two duplex oil pumps being provided, together with an oil cooler

The boilers four in number, of the Normand return flame type, are placed in two water-tight compartments, there being a smokepipe for each of the four boilers The total grate surface is 346.67, and the total heating surface is 16,177 square feet Normand feed water heaters were also provided for each fireroom, and proved very efficient In each fireroom are two blowers, designed and built by the contractors and fitted with forced lubrication. These blowers give most excellent service, and have shown themselves capable of delivering air at 9 inches pressure in necessary volume Further than this, each fan, with its engine complete, weighs less than 900 pounds.

The contract specified that the vessels should be given standardization trials of not less than twenty runs over the mile, a four-hour full-speed trial, on which the speed shown should average not less than 28 knots per hour, a twelve-hour trial at 24 knots and a twenty four trial at 16 knots, and that the water consumption per shaft horse-power should not exceed 25.2 pounds on the 16-knot trial 16.5 pounds on the 24 knot trial, and 15.5 pounds on the full-speed trial, all of these guarantees being met with a comfortable margin

The following table gives the results of these trials

	"Flusser"	'Reid"
Speed fastest mile	33.67 knots	34.55 knots
Mean speed five high runs	32.67 knots	33.75 knots
Maximum shaft horse-power developed	14,400	15,140
Mean speed four hours	30.41	31.85
Speed best 15 minutes four hour run	30.85	32.25
Revolutions necessary for 28 knots	706	700
Revolutions maintained four hours	801	846
Shaft horse-power four-hour trial average	11,541	12,564
I P C. auxiliaries four-hour trial average	301	310
Total horse-power four-hour trial average	11,842	12,874

No limit was placed upon air pressure on the standardization trials. The contract provided, however, that an average of 5 inches could not be exceeded on the four-hour trials, and the 5 inch average was maintained but not exceeded on both vessels.

Both the "Flusser" and the "Reid" are equipped with Parsons vacuum augmenters, built by the Bath Iron Works, which performed very satisfactorily, as vacuums were maintained on both vessels, at all speeds, of between 28½ and 29.9 inches.

The horse-power developed (maximum) per ton of machinery is the highest we know of, namely, 66 on the "Reid" and 64.7 on the "Flusser" It should be noted the weight of machinery (228 tons) includes every part coming under cognizance of the United States Bureau of Steam Engineering, namely, the machinery complete, with tools, water in boilers, condensers, filter tank and piping, floors, gratings, ladders, handrails steam heat, non-conducting corking and lagging, and evaporators and distillers.

* * *

The November Number of American Homes and Gardens.

The current issue of American Homes and Gardens contains many interesting features. Mr. Barr Ferree continues his series on notable homes and describes Villa al Mare, the country home of George Lee, Esq., at Beverly Farms, Mass John A. Gade contributes a very interesting article on the beauty and economy of stucco in the construction of the country house, or in the transformation of the old house. This article is illustrated by photographs showing the transformation of an old farm house into a habitable dwelling One of the most interesting subjects in the issue is that prepared by Francis D Nichols on a group of modern houses costing from $1,000 to $5,000 This article is profusely illustrated with photographs and plans and is particularly interesting to the man of modest means who wishes to build a home of modern style at small cost. Ralph C Davison writes on concrete ornaments for the garden and how to make them Kate Greenleaf Locke's article descriptive of four California bungalows is interesting, while Fritz Morris tells about the American Shetland pony S Leonard Bastin presents an article on a farming experiment by women Louise Shelton describes the garden of Hamilton House, and Robert Thompson tells of the beauties of 'Pine Haven," the summer home of Thomas B Van Buren Esq, at Kennebunkport, Maine. Alice M Kellogg solves some problems in home furnishings, and Charles Downing Lay tells about garden work around the home.

* * *

Prize for a Safety Automobile Crank.

A French association for the prevention of accidents in industrial work has offered $800 in prizes for a crank or safety device for hoists, cranes, and all forms of lifting apparatus, and also for explosion motors which shall in the first case, automatically stop the descent of the load, or in the second case, throw out of gear the driving action when not required. The invention remains the property of the competitor, who must himself be responsible for its due protection by patents. Drawings of competitive devices should be sent to the office of the Association des Industriels de France contre les Accidents du Travail, [illegible] Saint-André, Paris, France.

Correspondence.

THE INVENTOR OF THE STEAMBOAT

To the Editor of the Scientific American

I am indebted to a friend for the information contained in a recent issue of your journal relative to the Hudson-Fulton celebration in New York, in which under Fig. 1 you give a sketch of Jonathan Hulls's steam tug or boat, which you describe as being "proposed, but never built." With this statement I beg to differ, as it is quite contrary to actual facts.

You admit that the "complete description' is "of a practical steamboat," therefore I contend that the planning of a practical steamboat constitutes inventorship, if nothing "practical" existed previously This seems only fair argument, but I go further I am in the position to prove that the boat was actually built, from an official document viz Jonathan Hulls's treatise, published in 1737, as in this it is stated

"Whereas our Trusty & well Beloved Jonathan Hulls hath by his petition humbly represented unto Our most dearly beloved Consort the Queen Guardian of the Kingdom &c. That he hath with much Labour and Study, and at Great Expense *Invented* and FORMED a Machine for carrying ships & Vessels out of or into any Harbour against wind & tide, &c." And "the Petitioner hath made oath that he is the Sole inventor" etc., and he concludes his treatise by stating

"There is nothing in it but what is necessary to be understood by those that desire to know the Nature of that Machine which I now offer to the World, and I hope that, through the blessing of God, it may prove serviceable to my Country"

Now to prove practical results. I find in "The History of Progress in Great Britain," published in 1859 the following

"Thus we arrive at the time when in 1736 Jonathan Hulls' steam boat took a Sailing Ship in tow, and amid the wonder, doubts and jeers of the spectators made a great splash a loud noise and a black smoke yet managed to haul the cumbrous hulk along and gave promise that the child, which had distinguished itself by such an unheard of feat would one day become a giant of great strength"

What further or more convincing proof that the boat was actually built and proved practically successful can be required?

I would here mention that I have made a careful study of the claim of the many claimants from 1543 to 1807, a very lengthy period, and I challenge anyone to produce proof that will controvert Jonathan Hulls's right to the honor of being the inventor of the steam boat in 1736

My proofs consist of, among many others

1. Jonathan Hulls's specification No 556 (1736) old Law Series

2 Jonathan Hulls s treatise, written by himself (1737) Both still in existence at the British Museum and Patent Office Library

3 "History of Progress in Great Britain," published in 1859 Etc.

If you wish to pursue the subject further, I shall be pleased to submit many convincing proofs that the steamboat existed on this side, as also in America, long before the "Clermont,' which undoubtedly was not an invention of Robert Fulton's but merely the outcome of the inventive genius of one of Jonathan Hulls's methods of steamboat propulsion

I would be pleased to have a copy of your Hudson Fulton issue if you have a spare one, as I find some difficulty in procuring one here and in return I will assist you in reaching the actual indisputable facts as to who was the "inventor" of the steamboat.

J Hooper Hulls

Manor Park, Essex, England

LEDUC'S FIGURES.

To the Editor of the Scientific American

In the number dated August 14th, 1909, you give a description of M St. Leduc's experiments for obtaining plant-like *forms*.

I believe I was the first, some thirty years ago, when I showed these forms to my friend Sir William Crookes, and explained to him how such experiments can be conducted Any of your readers having at his disposal some solution of silicate of potash or of soda and some metallic salts crystallized, sulphate of iron, of copper, of nickel, etc., can reproduce the experiments.

By filling a glass two-thirds with a solution of one of these silicates then adding distilled water to the very top, and throwing some small pieces of the metallic salt (which will fall to the bottom of the glass) into the solution, he will see, in a short time, plants growing in different forms, sizes, and colors, according to the salt employed. The copper one will give a blue, the iron a dark green, the nickel a light green, and a beautiful plant will be obtained with chloride of cobalt.

By varying the density of the silicate solution, different effects in form, size, and color will be obtained.

If the solution containing the plants is kept well sheltered from the air by a good covering of the glass, these plants will keep any length of time

Paris, France Georges Fournier.

WHY DO WATCH SPRINGS BREAK?

To the Editor of the Scientific American

The mainspring of a watch does not unwind at a uniform rate, but intermittently It is subjected to a sudden jerk at every tick—four times per second for my Elgin watch This makes 345 600 times per day and over 126 million times per year This operating condition is analogous to others discussed in Kent's "Mechanical Pocket Book' under the heads of Relation of the Elastic Limit of Endurance under Repeated Stresses' and "Resistance of Metals to Repeated Shocks.'

Among other things it says "Another long known result of experience is the fact that rupture may be caused by a succession of shocks or impacts none of which alone would be sufficient to cause it. Iron axles, the piston-rods of steam hammers and other pieces of metal subject to continuously repeated shocks, invariably break after a certain length of service. They have 'a life' which is limited" Wöhler found in testing iron by repeated stresses (not impacts) that in one case 400,000 applications of a stress of 500 centners to the square inch caused rupture while a similar bar remained sound after 48 000 000 applications of a stress of 300 centners to the square inch (One centner = 110 2 pounds)

The mainspring of a watch is not only under a considerable tensile stress but also under a bending stress when suddenly released, then immediately stopped by the escapement mechanism It is then probable that its molecular cohesive power deteriorates in a manner similar to those quoted Henry Getaz.

Pittsfield, Mass

A MAGIC SQUARE

To the Editor of the Scientific American

The appended magic square is remarkable as containing the odd numbers in regular progression with in the inscribed square So far as I know it has not been published before

26	20	14	1	44	38	32
34	28	15	9	3	46	40
42	29	23	17	11	5	48
43	37	31	25	19	13	7
2	45	39	33	27	21	8
10	4	47	41	35	22	16
18	12	6	49	36	30	24

William P Doyle

Los Angeles Cal

THE BREAKING OF MAIN SPRINGS IN STORMS

To the Editor of the Scientific American

Respecting the breaking of main springs now discussed in the Scientific American it may be interesting to note what an old French watchmaker has to say regarding the rupture of springs in storms The following is a translation

"The influence of storms on the breaking of springs is certain, many watchmakers have observed it even ordinary rains may produce this effect. I have noticed it personally in quite a regular manner in the months of April and September which are generally rainy months, thirty per cent of the springs which I change in the course of the year are destroyed in these months by the influence of the rain This barometric influence acts much more on new springs than on those that have been working for a considerable time and these months are a critical period for testing their elasticity I have often been obliged after a short time to replace a spring that had thus been changed In one case I was obliged to renew the spring three times in the same day, though the springs had been carefully fitted"

Many of the watchmakers can cite cases of springs broken, not in a couple of pieces, but in ten or a dozen fragments, as if they had been divided by a saw Thus we come into the domain of electricity and watchmakers may be supposed to notice the effect without determining the cause

The quality of steel employed in the manufacture of springs and the care devoted to their tempering and annealing must be among the causes and it is for the makers of springs to give us information

Close observation has led me to believe that the contact of benzine or extreme oiling of the springs in stormy weather may not be completely foreign to their tendency to break.

Thus, when I change a spring during the critical period, I avoid passing it even rapidly into benzine I clean it by rubbing with a piece of peg wood and a rag slightly wet with fresh olive oil I do not wipe it and put it in without oiling as customary in ordinary weather I endeavor to substitute a slight lubrication for the oiling

This appears to me to be advantageous but I must acknowledge that it is not an infallible panacea It is to be hoped that other members of the profession will give the results of their experience

Brooklyn N Y Charles A Brassler

AN OPTICAL PHENOMENON

To the Editor of the Scientific American

In your issue of September 4th 1909 page 156 heading A New Speed Indicator for Marine Engines a device is necessary to enable engineer to correctly and intelligently interpret signals from the pilot or captain The camera device as described in a recent issue used on submarines when partly or wholly submerged would it seems put the engineer in a position which would enable him to interpret the signals by a visual comprehension of the location

The cost of installing one of the cameras on the upper deck so arranged as to give a clear front and rear view of the ship s situation with a reflection in the engine room should be inconsiderable

We must concede that there are times when the camera might be obscured by fog or smoke etc. At that time, if serviceable its utility might be greatest, but that is a time when attention is tense and is but a small proportion to the number of times when it would be effectively serviceable. The obscurity of the reflection *ipso facto* would be notice to the engineer to proceed cautiously and in case of doubt to ring for a repetition of signals

This letter is suggested by an experience I once had I was sojourning in the country in the lean to room of a log house The protection from the elements was a thin weather boarding As the fleecy flakes beat through the cracks and nail holes and with the cutting wind discomforted me I thought of a device whereby if I could not entirely obstruct I could at least reduce the force of the wind The next morning I bought and tacked some white drilling on the uprights about four inches from the weather boarding I was engaged in a perilous occupation and had been warned not to light my lamp without first lowering the shade in order that some unscrupulous owl meeting" participant might not make me the target of a 0 45 caliber Colt I neglected to reraise the shade and reentering my room my attention was arrested by a spot of green on the drilling Close investigation revealed in perfect miniature a reproduction in part of the landscape outside but reversed A small nail hole was the medium Though I have never experimented, I conclude the effect might be reproduced by tubes mirrors lenses etc so as to effectively show the surroundings of the ship in the engine room the engineer thus being partly in possession of the same information as the pilot or captain This suggestion is given for what it may be worth to you

Houston Tex G. O'C Macmanus

[This suggestion and the experience from which it originates are very interesting The phenomenon described is that of the camera obscura and can be as well produced with a pinhole camera as with a lens hence the result from the hole in the roof A similar effect may be observed if a sheet of paper be held a few feet away on the dark side of a door which is opposite the window of a room a picture of the window and the scene outside if the light is good appearing inverted on the paper There are only two objections to the use of such apparatus in a ship s engine room one is that the engineer is unaccustomed to observing the effect upon the ship of the speed he is getting out of his engines and the other is that he has enough to do in regulating his engines to give the speed desired by the pilot without also having to gage and decide upon the necessary speed Also such a camera could hardly be arranged to look forward and aft simultaneously without complicated piping with a mirror at each bend to avoid the ship s gear and we should say it would not be desirable to remove the navigating responsibility from the bridge to the engine room In the case of the submarine it is different the navigator cannot be above deck when submerged so uses the periscope but he is still responsible for gaging the desired speed and instructing the engineer—Ed]

The Current Supplement

The current Supplement No 1765 opens with an elaborately illustrated and exhaustive article on the recent Paris aeronautic exhibition Mr F W Harbord s article on iron and steel and their relation to other industries is concluded An extract is published of an interesting report on the advantages of treating the water in swimming baths with electrolytic fluid The mechanicians and especially the watchmakers of three or four centuries ago invented many ingenious mechanisms which have been forgotten Some of these are described in the current Supplement The dome just erected over the four great arches of the Cathedral of St John the Divine is an engineering feat of note, and is described and illustrated

HOW GERMANY MAKES FORESTRY PAY

BY FREDERIC BLOUNT WARREN

Germany has the highest developed system of forest management and conservation It has nearly 35 million acres of forest of which 31.9 per cent belongs to the State 1.8 to the Crown 16.1 to communities, 46.5 to private persons 1.6 to corporations and 2.1 to institutions and associations.

For each citizen there is a little more than three-fifths of an acre of forest and though 53 cubic feet of wood to the acre is produced in a year wood imports have exceeded wood exports for more than forty years, and 300 000 000 cubic feet valued at $80,000,000 or more than one-sixth of the home consumption, is imported each year

In forestry Germany has always led in scientific thoroughness the scientific knowledge has been applied with the greatest technical success, and it has procured an increasing forest output together with an enlargement of profits It will be interesting at the outset to state the European forestry theory the basis on which Germany and other nations have conducted their conservation work and statistics and summaries to come later to show that there has been a profit in the practice of the theory

In the cultivated forests of Germany the absence of underbrush and decayed logs and limbs the density of the forest and the even distribution of the trees often planted in long straight rows immediately arrest the attention One can walk with ease or drive anywhere among them except where the hills are too steep or stony or where the trees stand too closely together this always being the case in young woods The trees are not permitted to reach the full limit of their life and then as the result of decay to fall and remain rotting on the ground They are considered as wood capital, which adds interest to itself as long as the trees continue to grow, at first slowly when the trees are small more rapidly when they are of medium size and more slowly again when they become large When the trees die the wood interest ceases entirely and as they decay the capital is reduced The forester leaves this wood capital as long as the interest continues satisfactory Then, when the growth declines it is removed, the forester taking the trunks and limbs and the peasants gathering up the brush and often digging up the stumps, although these too are frequently taken care of by the forester and sold in the market to pay the cost of their removal In some German districts all the products are marketed In Mecklenburg a good layer of leaves and moss sells for $16 an acre In some sections a nominal sum is charged for brushwood In the Spessart Bavaria it has long been the right of peasants to gather the forest litter without charge Sometimes this permission applies to the gathering of nuts which are used as food for domestic animals

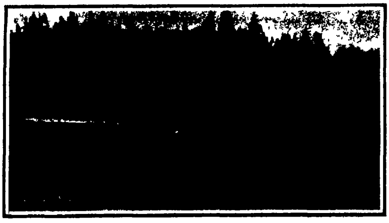
The United States has 164 000 000 acres of land in the 165 national forests besides 2 722 726 acres of State owned forests and 40 000 000 acres of woodland in the Philippines And the table below taken from official government statistics in a United States Forest Service bulletin is what our national forests return as a federal investment compared with the Saxon figures

In this statement the American may learn the difference between advanced European forestry at almost its highest profit and the lesser profit just beginning to accrue to the United States as a result of its endeavor to foster its wood producing resources Saxony's total area amounts to 5 780 English square miles of which almost one half is covered with private and governmental forest The last the State treasurer places as the highest revenue producer after the State railway and they exceed the revenues from all other sources taxation included The total quantity of timber cut in 1906 is estimated at 1 231 472 cubic yards (33 250 497 cubic feet) representing woods used for fuel and for all other purposes To this must be added a yield in brushwood cut and sold for fuel use principally of 190,415 cubic yards (5,140,906 cubic feet), raising the total quantity of timber and brushwood cut and sold to 1,421,887 cubic yards (38,391,403 cubic feet) for which $3,374,385 was obtained. This amount was increased by additional revenues from the leasing of meadows, hunting privileges, and other rights to the total of $3,483,616 Deducting from the total figures the cost of forest cultivation, with salaries and wages of the entire service included, amounting to $1 357 580 the net profit of $2,126,036 was added to the treasury in 1906. There is nothing unusual in this result as the ten preceding years show equally high figures, a few slightly exceeding the 1906 revenues, and others being lower in a very slight degree.

Country	Total Net Revenue from Government Forests		Expended per Acre	Net Revenue per Acre.
Saxony		$2,126,036	$3 05	$5.30
United States	1905 6	12,000*	0.007	*0.0001
	1906 7	164,659	0.0098	0.00086

* Represents deficit.

More and more accustomed to weighing questions, whether national or individual, in dollars and cents, there is contained for the American public in the above official statement the most potent argument for increased conservation of forest lands. Systematic state forestry began in Germany 150 years ago when the country felt the pinch of a wood shortage, but there were also contributory causes such as the effect upon agriculture and stream flow due chiefly to erosion Just across the border, France denuded of its forests was having trouble with its mountain torrents and the Germans opened their eyes to the dangers of floods in their own lands. Protective forests were provided for by Bavaria in 1852, by Prussia in 1875 and by Württemberg in 1879 Now all of the German states practise forestry with success



Part of forest tree nursery, Thüringen, Germany.

In Prussia the forests cover nearly 7 000 000 acres, and methods of management adopted call for a sustained yield In consequence, the productivity has been multiplied threefold in seventy five years In 1830 the yield was 20 cubic feet an acre in 1865 24 cubic feet, in 1890 52 cubic feet, in 1904, 65 cubic feet

Saxony has 430 000 acres of State forests, and its yield rose 55 per cent between 1820 and 1904 It is now 93 cubic feet an acre These increases are not limited to Germany, since other European nations notably Italy and Switzerland are now reaping large revenues from their timber lands

Forest tree nursery in the Thüringen Wald, Saxe-Gotha.

HOW GERMANY MAKES FORESTRY PAY

Where Saxon forests are yielding $5 30 an acre, those of Württemberg yield a net annual revenue of $6 and those of several smaller administrations exceed this! There are also a large number of private forests managed with great success whose revenues equal or exceed $6 an acre For 15 600 000 acres of state, municipal and private forests included in a canvass, it was found that the average net annual revenue an acre—from good bad, and indifferent land—was $2 40

The forests are managed largely in compartments, each of which, when the mature trees are considered ready for removal, is cut clean and planted with a new crop. Sometimes the compartments are located so that the cutting proceeds regularly in one direction as a protection against the prevailing winds, and at intervals of perhaps ten years, in which case the forest shows distinctly ten or twelve "age classes," arranged in a series of progressive heights. If a compartment is harvested and restocked each year, the number of age classes will of course equal the age to which the trees are allowed to grow "Cutting clean" is most commonly in use in pine and spruce forests of Germany These trees are mostly started in nurseries where the seeds are sown. In two years they are transplanted when six inches high. They grew in two or three years more to be twelve or fifteen inches tall, and then they are moved again to denuded fields and replanted about four feet apart, so that in a short time they will begin to crowd each other This condition compels the trees to grow tall and slender and to shed their lower branches, thereby permitting a growth of timber free of knots. The trees are usually planted in straight rows, and in about twenty years a thinning is necessary In spruce forests sometimes more than half of the trees are removed at the first thinning." These are sold for fire-wood poles, and various other uses. The fuel wood, laid at the roadside, brings about $2.25 a cord Subsequent thinnings are necessary about every ten or fifteen years Building material laid at the roadside brings nine cents a cubic foot, good spruce fuel wood $3 a cord On the poor sandy soil of Mecklenburg a thinning in Scotch pine when the trees are twenty years old yields only about $2 an acre, when forty, $5, when sixty, $10, when one hundred, $30 In the Erz Mountains, Saxony, thinnings when twenty years old bring $4, when forty, $15, when sixty, $80

Every product of the forests of Germany and southern Europe finds ready utilization This is due to the good market, population, low wages, and good roads. The effect of the market is everywhere apparent in the great economy of wood In hotels heat is a luxury for which guests often pay an extra charge Village and forest houses are seldom constructed of wood Walls of plaster or cement are the rule Floors are made of stone in many cases and tiles and iron take the place of shingles Wooden fences board sidewalks, and block pavements are uncommon

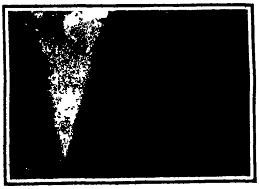
Yet the forests which cover one-fourth of the area, fall far short of the requirement. Germany imports more than 300 000,000 cubic feet of timber paying the duty of 28 cents for every 210 pounds of rough timber or logs and $1 15 for every 210 pounds, or one cubic meter (35 3 cubic feet) of dressed timber Germany's own production of timber amounts to more than 600 000 000 cubic feet. If Germany were to supply the deficiency from its own soil it would need an additional 20,000,000 acres The percentage of forestry soil would be increased from 26 to 40 per cent of its area It is doubtful if there are more than 2,500,000 acres for this purpose If every available spot were utilized and all the waste lands that are not well adapted for agriculture were planted in pine, spruce, fir and other trees it would require fifty years for them to be ready for market, and then the supply would not equal the demand Only Bavaria and Württemberg have a surplusage of home timber

It is the custom to buy individual trees rather than forests. There is a market unit of volume by which timber is generally purchased, called the "festmeter" It is a cubic meter (35.3 cubic feet) and is equivalent to 1.44 markets, or 19-inch standards, or about 288 feet board measure. In America large and small logs are scaled and sold together In Germany when the trees are felled, each one is marked with a number stamped in the butt. They are then sold by number in five or six classes according to size

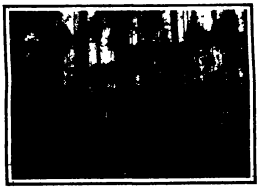
Recently in the Harts $22 65 a thousand feet, board measure, was offered for spruce tree trunks containing more than 300 feet $18 56 for trunks containing from 150 to 300 feet and for smaller sizes about $15 The live market for wood appears also in the number of metal railroad ties, being used in one-fifth of the entire mileage The use of wooden ties in recent years has been greatly encouraged however by the discovery of methods of impregnating wood with such preservatives as creosote, chloride of zinc, or sulphate of copper

As the forests are to be lumbered perpetually, the roads are made for permanency They consist often of stone, laid with much expense and not infrequently

A good seed year for Norway spruce near Eisenbach, Thüringen Wald.



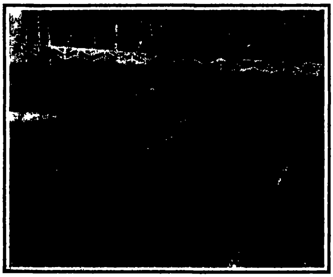
Prince Bismarck's forest at Friedrichsruh, North Prussia. Fire lane.



City forest of Grabow, Mecklenburg, Germany.

Hauling timber in the Schwarzwald, Geroldsau, near Baden-Baden.

Royal forestry institute, Vallombrosa, Italy. Nursery in the background.



Forest tree nursery near Gerardmer, France.

Preparing ground for a forest plantation in the Spessart, Northern Bavaria.

HOW GERMANY MAKES FORESTRY PAY

macadamized. In 1903 Saxony spent $175,000 on forest roads, and larger sums have been expended since by several States in the German federation. The roads at Geroldsau, in the Schwarzwald, are especially fine for forest hauling.

Germany's sawmills are usually small. Most of them would not cut more than 25,000 feet, board measure, in a day of ten hours Almost any fair-sized American sawmill cuts 100,000 feet a day But the small mill of Germany is permanent, being supported by perpetual crops of timber hauled to it by wagon or shot down streams. While some railroads carry logs, and rafts are still floated down the Rhine, Elbe, and other rivers, the method of hauling is very largely by wagon or by the old fashioned American "carry log" Along the Ens River in the Black Forest are located some of the largest mills, and to these the stock comes mostly on the railroad in long large logs, much of it being brought from Württemberg and Swabia. For each load of logs two cars are necessary

In Austria there are 24,000 000 acres of forest, of which 7 per cent belongs to the state. Private owners hold 58 per cent. As Austria has been independent of the German Federation only since 1866, its forestry system, in the main, has followed German lines Private forestry is encouraged by a system of taxation which relieves forests in which forestry is practised The total net annual state forest revenue is $5,000,909 The net yearly revenue of 21 cents an acre is comparatively low, due mainly to the facts that only 56 cents an acre is expended, and that most of the area is located in the rugged Alps and Carpathians, where administration and logging are costly The forest department was started in 1872, and reorganised in 1904 into three departments—administration proper reforestration and the correction of torrents and forest protection Forestry is successfully practised on 60 per cent of all the State forests, and on 82 per cent of the private forests The most conspicuous fruit of the State forestry is the restoration of the "Karst," a stretch of barren lands in the hilly country of Istria, of Trieste, Dalmatia, Montenegro and neighboring territory along the Adriatic Sea. It comprises 600,000 acres. This work has been carried on by the Forest Protective Service which was first created for Tyrol in 1856

In Hungary there are 23 000 000 acres of forest of which the State owns 16 per cent corporations 20 other institutions 7 5, and private persons 56 5 From ten to twelve million dollars worth of wood is annually exported, and the State forests yield $600 000 revenue Austria exports 3 670 000 tons of wood the greater part of it going to Germany About half of all the Hungarian forests is under working plans by which the annual cut of 1 000 000 000 cubic feet is regulated Forest planting is encouraged by the State nurseries, at which 10,000 000 seedlings are raised each year for free distribution and by bounties paid for forest plantations on private waste lands

Since dead timber is not left in any forests, there is but little loss from fires. In Saxony this is rarely more than $300 a year, Württemberg, about $650, and the Duchy of Baden with 240,000 acres had only 99 acres burned in nine years Fires are started mostly by careless smokers and workmen Locomotives cause about ten per cent In many places along the forested side of a railroad track there is a ditch about eight feet wide which is kept free of vegetation Frequently a strip of forest about a rod wide, running parallel with the railroad is prepared in the following manner A path along the edge of the woods is spaded about four feet wide In the forest about a rod from this and running parallel with it, a second path is made. Cross paths are made at intervals of about a rod These paths are free of vegetation and the ground in the strip is raked of leaves and twigs

In Germany forestry is a well established profession for which the candidates must prepare themselves thoroughly They must learn the science in a forestry school where the course of study requires much hard labor After graduation they must practise the science under masters for several years These masters are usually officers having charge of ranges A candidate takes first a position called in Germany "Forstreferendar at a salary of about 1 200 marks ($286) In two or three years he is advanced to that of Forstassessor at 3 000 marks ($714) With successful service he may then be promoted to the position of 'Oberförster with a salary of 4 500 marks ($1,071) and a dwelling especially suited to his needs

THE HEAVENS IN NOVEMBER.

BY HENRY NORRIS RUSSELL, PH.D

THE principal astronomical news of the past month has been the finding of Halley's comet, which was announced by Prof Wolf of Heidelberg who succeeded in photographing it on September 11th. Faint images of the comet were later found on photographs taken at Greenwich two days before which were given relatively short exposures to avoid the danger of fogging by moonlight If the moon had been out of the way the comet might have been observed a week or two earlier

It is still an extremely faint object a mere nebulous disk with no trace of a tail visible only in very large telescopes and will remain faint until next spring

At the time of discovery it was more than 300 million miles from both the earth and the sun It is now approaching them and moving slowly westward in the heavens on the boundary of Taurus and Orion On December 1st it will be in opposition but will be too faint for small telescopes (about the 12th magnitude) It will continue to approach the earth until December 18th when its distance from us will be about 125 million miles After this it recedes from us as its motion about the sun is retrograde (i e in the opposite direction to that of the earth) and passes on the far side of the sun about March 24th 165 million miles from us Then it advances to meet the earth passes between us and the sun about May 17th and a few days later comes very near us within about 12 000 000 miles At this time the comet will be well observable in the early evening and in all probability an impressive object In a few days more it will double its distance from us and later it will gradually diminish in apparent size and brightness till it fades from view, though it should be telescopically visible until the end of 1910

It is not usual that the motion of a comet can be so accurately foretold within a few weeks of its discovery but Halley's comet has not really been discovered at all this time It has only been reobserved after an interval of more than seventy three years since it was last seen and after this long interval the time of its return was predicted with an error of about one day This would be a perfectly easy matter if the comet moved under the influence of the sun's attraction alone for then it would return at exactly equal intervals But the attraction of all the planets comes in to modify its motion and may alter its period by several years so that the actual calculation of a return is no easy problem and the success attained in this instance by the English astronomers Cowell and Crommelin (who have made an exhaustive investigation of the subject) is one of which science may legitimately be proud They have been no less successful in unraveling the past history of this remarkable member of our system but the story of that must wait till next month

Next among the events of the month from our standpoint must be mentioned the observations of Prof Campbell on Mount Whitney California These show no perceptible difference between the intensity of the absorption bands due to water vapor in the extreme red end of the spectra of Mars and of the moon It follows that the amount of water vapor in the atmosphere of Mars must be small compared even with that in the rarefied and remarkably dry air above the mountain at the time of observation

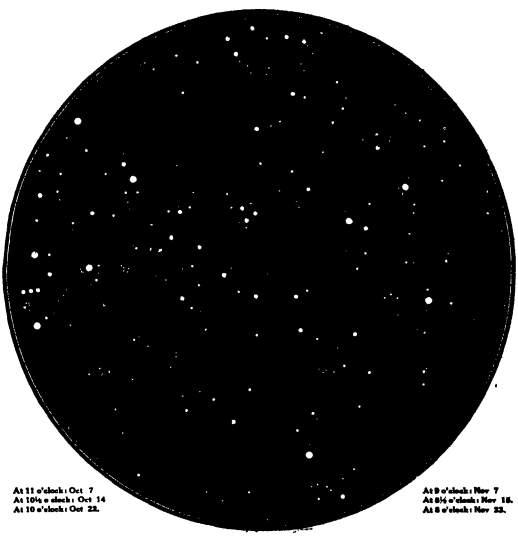
Prof Lowell's observations which indicated a perceptible amount of water vapor in the Martian atmosphere, were made under conditions which though very favorable, appear to have been hardly as good as those on Mount Whitney. What is the cause of the discrepancy it is too early to say, but it is just by the investigation of such differences that the art of observation is perfected, and it is not unreasonable to hope that the study of this case may lead us, not only to more definite conclusions concerning the atmosphere of Mars, but to still better methods of investigating the problem in future

THE HEAVENS

Turning to our map of the sky, we find Cassiopeia almost overhead The five brightest stars of this constellation, forming a group which looks like a badly dilapidated letter W, can be immediately identified

With the aid of the fainter star $\varkappa$, we can see a resemblance to a rather less dilapidated chair, with its feet away from the pole, but the conventional figure of the Lady in the Chair" is turned just the other way, with feet toward the pole, and our initial illustration is one more example of the large share of the imagination in forming the constellation figures

Several individual stars deserve notice The line through the Pole star and β Cassiopeiæ points almost exactly toward the vernal equinox It may therefore be used as an indicator to estimate the sidereal time —remembering that it is above the Pole at sidereal noon to the left at 6 h below at 12 h, and to the right at 18 h With a little practice it is possible to read the sidereal time from this celestial bow band within about fifteen minutes. Then, by recalling that the sidereal clock agrees with the mean solar clock on March 22nd (or thereabout) and gains at the rate of two hours a month one can pass to ordinary solar time This is the simplest way to tell the time by looking at the stars



At 11 o'clock: Oct 7
At 10½ o'clock: Oct 14
At 10 o'clock: Oct 22.

At 9 o'clock: Nov 7
At 8½ o'clock: Nov 15.
At 8 o'clock: Nov 23.

At 9½ o'clock: October 30.

NIGHT SKY: OCTOBER AND NOVEMBER

β Cassiopeiæ is also notable as a fairly near neighbor of ours having a parallax of about 0 10 sec, corresponding to a distance about two million times that of the sun or 32 light years. Two other naked-eye stars near by are nearer One of them η is marked on the map between α and γ This is a well known binary with a period of over 200 years and a parallax of 0 19 sec corresponding to a distance of 17 light years

The other, μ Cassiopeiæ, is the southern and fainter of a pair of stars which lie near the other corner of the parallelogram whose vertices are α, γ and δ Its parallax is about 0 11 sec and its distance 30 light years It is notable for its great proper motion 3 7 sec per year which corresponds to an actual velocity in space of 100 miles per second

The familiar winter constellations are beginning to return to the evening sky At any hour of observation, Taurus is well up in the east, and Orion is rising. Gemini too is on the horizon, and Auriga is well up in the northeast. Perseus, Andromeda, and Pegasus extend upward from this to the zenith, and beyond it.

The southern constellations are inconspicuous, but Mars and Saturn, the first near the meridian and the other east of him, add luster to the otherwise vacant region. The variable star Mira (o Ceti) is now near maximum. It may easily be found with the aid of the map.

The two bright stars below and to the west of Saturn and Mars are β Ceti and Fomalhaut, which are much more nearly equal in brightness than the map would indicate.

Another group of bright stars lies in the west. Deneb, in Cygnus, is highest up Altair is on the left, and Vega, the brightest of the three, below the first.

The Great Bear is low on the northern horizon, almost out of sight. Draco and Ursa Minor are above, and Cepheus higher still, close to Cassiopeia.

THE PLANETS

Mercury is morning star throughout November. He is best visible at the first of the month, when he rises about 5 15 A. M By the middle of the month he has drawn nearer to the sun, and rises about 6 o'clock, and soon after this he becomes unobservable without a telescope, with which he is best seen in broad daylight.

Venus is evening star, a long way from the sun, but very far south, so that she sets before 7 30 P M.

Mars, though past opposition and receding from us, is splendidly conspicuous in the evening sky, coming to the meridian about 9 P M at the beginning of the month, and 7 30 at its close.

Jupiter is morning star in Virgo and rises at about 3 A. M in the middle of the month Saturn is in Pisces about an hour east of Mars, and is on the meridian at 9 30 P M on the 15th

Uranus is evening star in Sagittarius, setting too early to be well observable On the 23rd he is in conjunction with Venus, being 2½ deg north of the latter

Neptune is in Gemini, and comes to the meridian about 4 A. M. during the middle of the month

THE MOON

Last quarter occurs at 4 P M. on November 4th, new moon at 9 P M on the 12th, first quarter at noon on the 20th and full moon at 4 A. M on the 27th, during the total eclipse of that date

This lunar eclipse is visible throughout North America and the adjacent regions, but at an inconvenient time for the amateur, in the small hours of the morning

The moon enters the earth's penumbra at 1 12 A M eastern standard time and first reaches the full shadow at 2 11 At 3 14 she disappears completely in it, and does not begin to emerge till 4:37 This is an unusually long duration, due to the fact that the moon goes almost centrally through the earth's shadow which itself is larger than usual, as the moon is near the earth

At 5 38 the moon finally leaves the shadow, and exactly an hour later she gets clear of the penumbra, and the eclipse is over

The moon is nearest to us on the 25th, and farthest off on the 9th She is in conjunction with Neptune on the 2nd, Jupiter on the 9th, Mercury on the 11th, Venus on the 16th, Uranus on the 17th, Mars on the 22nd, Saturn on the 23rd and Neptune once more on the 30th

Princeton University Observatory

* * *

Carbon Safety Ink—This ink is really no more than a sort of India ink kept in solution It may be made by rubbing down 10 parts of lampblack, 10 parts of gum, 5 parts of oxalic acid, and 200 parts of water, taking at first but little water and only adding the remainder after the thick mass has become uniform.

Patent Department

AN IMPROVED PLANTER

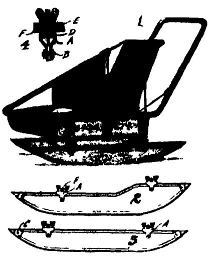
Pictured in the accompanying engraving is a planter provided with a seed box, in which there are no springs to become chocked or gummed by seed or dust. The seed-distributing mechanism is adaptable for seeds of different sizes, and may also be adjusted to plant seeds at greater or shorter distances apart. The seeds leave the box so close to the ground that there is no danger of their becoming scattered. The frame of the machine is supported on a traction wheel *A*, which, through the medium of suitable gearing, operates a bevel gear *B*, affixed to a vertical shaft which runs through the seed box *C* Secured to the forward part of the seed box is a share *D*, which plows a furrow in advance of the seed box, while a pair of hoes *E*, converging rearwardly, serve to cover the seed with the earth plowed up by the share. A disk *F* is secured to the shaft which runs through the seed box and is adapted to rotate in contact with the bottom plate of the seed box. The disk is provided with a series of perforations, adapted to be brought successively into engagement with an aperture *G* in the bottom of the seed box. A cut-off *H* bears against the disk *F* immediately above the aperture *G* A rod attached to the cut-off *H* extends through the top of the seed box, and is normally pressed downward by means of a spring *J* As the disk *F* revolves, it carries one seed at a time to the opening *G*, through which the seed falls into the furrow The machine is supplied with disks having perforations of different sizes, suitable for seeds of various sizes, and the intervals between the perforations vary in the different disks to provide the proper spacing of the seeds planted If desired two or more seed boxes may be connected to the traction wheel, so that a number of rows may be planted at the same time. The inventor of this planter is Mr August Brinkoeter, Floresville Texas.

AN IMPROVED PLANTER.

◆

SLEIGH-RUNNER ATTACHMENT FOR BABY CARRIAGES.

A patent has recently been issued disclosing a new form of sleigh-runner attachment for baby carriages, which may readily be applied to an ordinary go-cart or baby-carriage or a child's wagon, to permit of using it over snow-covered walks The accompanying engraving indicates the form of this attachment The runners, which are made of T iron, consist of a horizontal upper and lower member, with the ends of the lower member curved upward and braced by means of plates *C* The axles of the carriage are made fast in a pair of saddles mounted on each runner The form of the saddle is shown to better advantage in the cross-sectional view, Fig 4 It consists of a yoke *A*, which fits over the horizontal portion of the T iron, and it is made fast by means of a bolt *B* on the under side. A pair of bolts *D* with flat heads *E* resting on top of the runner project upward through the yoke to receive a strap *F* which is clamped down on the axle by means of a pair of thumb nuts. When it is desired to attach the runner to a folding go-cart a sleeve is preferably fitted over the axle and this sleeve is clamped between the strap and the yoke Fig 3 shows a form of runner used on vehicles which have rear wheels of larger diameters than the front ones It is quite essential to have the rear as well as the forward end of the runners curved, because this enables one to lift the forward end of the baby carriage when mounting a curb, or when it is desired to make a sharp turn. It also permits of lowering the carriage from a step or the curb The runners may be quickly applied or removed by merely turning the thumb nuts, and they are applicable to any type of go-cart, owing to the fact that the saddles may be adjusted along the upper member of the runner, and made fast at the desired point by tightening the bolt *B* The inventor of this attachment for baby carriages is Frederick C Kengeter, 2656 Pitkin Avenue Brooklyn N Y

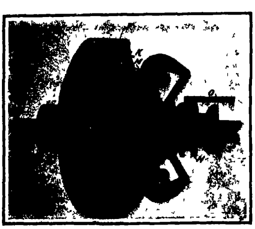


SLEIGH-RUNNER ATTACHMENT FOR BABY CARRIAGES.

◆

COMBINED FRICTION AND JAW CLUTCH.

The principal advantage of a friction clutch is that it permits the shaft under load to be brought gradually up to the speed of the power shaft, thus eliminating the shock of starting However the friction surfaces are liable to wear out rendering the clutch useless in a short time Except for starting and stopping the jaw clutch is better because it provides a positive engagement of one shaft with the other The accompanying engraving illustrates a clutch in which it is aimed to combine the advantages of both forms The power shaft is indicated at *A* and the load shaft at *B* Mounted on the shaft *A* is a hub *C* formed with a flange to which the disk *D* is bolted Projecting through a central aperture in the disk *D* is an annular jaw *E* The disk *D* at its periphery is formed with an annular flange which incases part of the clutch mechanism A ring *F* is fitted within this flange and keyed to it The ring has openings at suitable points to receive wooden blocks *G* which protrude from the opposite faces of the ring Keyed to the shaft *B* is a member *H* on which is fitted a sleeve *I* formed with a flange at its inner end A series of bolts *J* are fitted between this flange and a ring at the opposite end of the sleeve. A ring *K* is mounted to slide on the sleeve *I* and the bolts *J* pass therethrough while coil springs on the bolts *J* bear against the ring *K* tending to press the latter outward The flange of sleeve *I* and ring *K* have annular bearing surfaces adapted to engage the blocks *G* at opposite sides They are pressed into engagement by means of levers *L* fulcrumed to the ring at the end of the sleeve *I*, and links *M* are fitted between the levers *L* and the ring *K* The levers *L* are connected by links to a sliding collar *N* operated by a lever *O* fitted with a split collar in the usual manner The collar *N* slides on a sleeve *P*, which at its inner end is provided with jaws *R* These jaws are adapted to slide in recesses at opposite sides of the member *H* and the jaw *E* In operation when it is desired to separate the jaws the lever *O* is operated to draw the collar *N* back on the sleeve *P* This serves to press the flange *I* and ring *K* against the friction blocks *G*, thus taking the load off the jaws, and when the collar *N* comes into contact with the flange *S* at the end of the sleeve *P*, the jaws *R* are withdrawn from engagement with the clutch member *E*, after which the friction surfaces are released owing to the toggle action of the links connecting to the collar *N* When throwing the clutch into engagement the reverse takes place The friction surfaces are first thrown into contact before the jaws *R* move into engagement with the recesses in the clutch member *F* It will be understood that the frictional engagement is only momentary serving to bring the load shaft approximately up to speed and thus obviating the shock of starting and the danger of breaking the clutch jaws The inventor of this combined friction and jaw clutch is Mr Charles Stewart Hook 79 Victoria Street, Toronto Ontario Canada



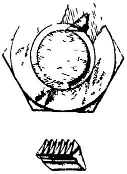
COMBINED FRICTION AND JAW CLUTCH.

◆

A PERFECTED FORM OF LOCK NUT

Of the many kinds of lock nuts which have been, or are at present manufactured few have the simplicity and surety of the one recently patented by Mr William Jacobus, and soon to be placed on the market. The accompanying engraving shows at a glance the extreme simplicity of this invention, which consists in cutting from an ordinary nut a small wedge-shaped section that when it is put back in place and the nut is screwed up jams tightly against the thread as soon as an effort is made to unscrew it. When it is desired to remove the nut the wedge can be released by a pin or piece of wire and the nut can be unscrewed

Two capital advantages of this new nut are that it practically is in *one piece* resembling in general appearance any ordinary nut and secondly the fact that vibration tends to tighten instead of loosen it. An excellent demonstration of this latter fact was given us by the inventor who placed a nut about half way up the thread of a bolt and by jerking the bolt up and down on the end of a string caused the nut to travel to the end of the thread where it was effectually locked

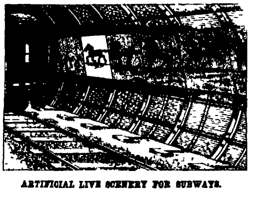


A PERFECTED FORM OF LOCK NUT

◆

ODDITIES IN INVENTION

MOVING PICTURES FOR SUBWAYS Moving pictures are produced, as is well known by a film traveling with intermittent motion before a projector or lantern which throws successive views on the screen The same result could be obtained if the pictures were stationary and the audience itself were in motion so as to view the pictures successively An ingenious inventor has hit upon this scheme to relieve the monotony of subway travel He proposes to mount a continuous band of pictures at each side of the subway and have these pictures successively illuminated by means of lamps placed behind them The circuits of the lamps would be successively closed by means of a shoe upon the subway car engaging contact plates at each side of the track The accompanying illustration indicates the method of accomplishing this result.



ARTIFICIAL LIVE SCENERY FOR SUBWAYS.

◆

Fluid Siccative—60 parts of old linseed oil are boiled with 3 parts of carbonate of manganese until viscid The temperature required is about 536 deg F (280 deg C) The mass should then be dissolved in 120 parts or more of oil of turpentine

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

TROUSERS SUPPORTER.—S. Irwin, New York, N. Y. In this construction an elastic belt is wholly contained within the trousers, and has wire loops or their equivalent attached to its opposite ends and adapted to engage over a button at the front of the trousers in holding them in place. The invention also provides in connection with the belt adjacent to its ends drawers supporters which engage with the supporting loops of the trousers when the ends of the belt are detached and prevent the passage of the ends therethrough.

Electrical Devices.

ELECTRIC SWITCH.—H. D. Grinnell, New Bedford, Mass. The switch is more especially designed for turning on or off the gas supply for the lamps of an automobile or other motor vehicle and at the same time controlling the igniting devices for said lamps. The result is obtained by the use of a manually-controlled switch shaft having an arm carrying a pinion in mesh with an internal gear wheel formed of alternating insulated and contact making sections.

ELECTRICALLY OPERATED AUTOMATIC SWITCH.—W. A. Lacke, Chicago, Ill. One advantage in this device is the fact that the solenoids are dead at all times except when in the act of moving the damper. In case a contact closes and the damper regulating mechanism is in consequence actuated, the closure hereafter of the same contact will have no effect and will not waste any current. It is only when another contact is closed and current is needed for moving the damper in the opposite direction that any current whatever is able to flow.

ELECTRIC LIGHT BRACKET.—L. L. Darey, New Orleans, La. The invention relates more particularly to brackets which include a body provided with a bulb-carrying socket, clamping jaws for removably securing the feed wires in place on the body, and a ring, the latter serving removably to engage the jaws to fasten the same firmly in place.

Of Interest to Farmers.

ATTACHMENT FOR RIDING CULTIVATORS AND OTHER AGRICULTURAL IMPLEMENTS.—C. N. Simpson, Bryan, Texas. This attachment may with slight changes in the implement be placed upon a riding plow, a riding cultivator, or a planter, and enable an exact control, so that the plows proper or cultivator blades may be instantly changed in adjustment to lower or raise their points in conformity with changes in inclination of the surface of the ground, thus insuring equal proper depth of furrow or agitation of soil in level and undulating ground, and when the implement is turned at a fence row.

COTTON MARKER FOR BALES.—G. W. Long and E. Otidis, Lindsay, Okla. In the present patent the invention is an improvement in cotton markers for use on bales of cotton, whereby the bale when being tied out will operate to permanently bind the marker to the bale by the ties, which hold the bale in compression.

Of General Interest.

ENVELOP.—N. J. Macdonald, Irish Cove, Nova Scotia, Canada. This invention refers to certain improvements in envelops, and more particularly to a special flap construction, whereby after the envelop is sealed it is very difficult, if not impossible, to gain access thereto without leaving evidence of the fact that the envelop has been tampered with.

APPARATUS FOR THE BACTERIOLOGICAL TREATMENT OF SEWAGE AND THE LIKE.—O. A. Lucas, 7 Rue Voltaire, Levallois-Perret, Seine, France. The invention is an improvement in apparatus for the bacteriological treatment of sewage, fecal matters, domestic waste water, and the like. It may be installed in dwelling houses, thus permitting the destruction on the spot and in a complete manner of the organic germs contained in sewage. It is an improvement over a prior patent granted to Mr. Lucas, and treats sewage successively by anaerobic and aerobic fermentation and oxidation.

FURNACE FOR SMELTING ORES.—W. Kemp, Tucson, Ariz. Ter. This invention relates to furnaces, and admits of general use, but is of peculiar value in furnaces provided with water jackets and adapted to be used in connection with burners for smelting ores. Upon actual test this furnace has proven more efficient than the old style furnaces.

HOLDER.—I. Hirzelberg, New York, N. Y. The object here is to provide a holder or box for containing court plaster, postage stamps, and like articles, and arranged to accommodate a large number of articles in a comparatively small space, to allow convenient removal of an article as required, and to protect them against deleterious influences of moisture.

BALE TIE.—H. O. Lay, Bridal Veil, Ore. The purpose of the invention is to provide novel details of construction for a bale tie, especially well adapted for holding a wire strand bound tightly around a bundle of shooks, lath, shingles, or other material, to adapt such material for convenient handling and transportation.

FIRE EXTINGUISHER.—D. H. Conkling, Fort Pierce, Fla. The invention relates to improvements in extinguishers in which a mixture of sulphuric acid and bicarbonate of soda is combined to form carbonic acid gas which possesses powerful extinguishing properties. Means are provided whereby the extinguisher may be instantly and automatically recharged by the returning of the extinguisher receptacle to its normal or upright position.

TYPE WRITER CABINET.—J. D. Cleaton, Atlanta, Ga. The object of the inventor is to provide an office desk of the usual form with a compartment at one side of the central knee space with means to assist in lifting the typewriter from the compartment, up through the top of the desk and to dispose it over the knee space to be further shifted if desired to a more central position.

NON-REFILLABLE BOTTLE.—J. S. Bromhead, New York, N. Y. The invention provides a bottle arranged to insure a steady flow of liquid from the bottle when tilting the same, and prevents refilling of the bottle by unauthorized persons after the bottle is once emptied of its original contents. It relates to non-refillable bottles such as shown and described in Letters Patent of the U. S., formerly granted to Mr. Bromhead.

Hardware.

FLUSHING DEVICE FOR WATER CLOSET TANKS.—J. F. Young, Owatonna, Minn. The purpose of this inventor is to provide an independent automatic locking device adapted for use in connection with the customary float locking supply valve, and which, although it may be used for other purposes, is especially designed to be employed in water-closet tanks.

SOCKET PIECE FOR STUDDING, ETC.—W. P. Rice, Lowell, Ohio. The object of the invention in this case is to provide a device especially adapted for securing the beveled end of a piece of timber against the side of another piece, as for instance in securing the legs of trestles to the body portion.

RAZOR BLADE SHARPENER.—D. M. Perine, Pittsburg, Pa. An object of this improvement is to provide a device by which the blade may be sharpened evenly, such result being obtained by disposing the blade holder on a pivot centrally located between two sharpening disks.

STRAP SEAL.—S. Baruch and M. Dessauer, New York, N. Y. The invention comprehends a fastening for holding together the ends of the strap or straps to be connected, and a seal comprising a plate of sheet metal bent around the overlapping portions of the strap or straps and secured by aid of eyelets so as to conceal and protect the fastening.

PADLOCK.—I. A. F. C. Byrne, Lahore, Punjab, India. More particularly the invention relates to a padlock of the kind comprising a casing, a rotatable shackle mounted to project partly from the casing, a slidable member which in a predetermined position holds the shackle against movement, and key-operable tumbler levers controlling the slidable member.

Heating and Lighting.

FURNACE FOR UNIFORMLY HEATING METALS.—W. N. Best, New York, N. Y. The invention has reference to certain improvements in furnaces adapted for use in heating forgings, castings, or the melting of metals, and the object of the inventor is to so construct the furnace that the temperature of all parts of the heating chamber will be the same.

Household Utilities.

STRAINER.—G. F. Grimm, Evansville, Ind. The main object in this case is to provide a device by which a strainer may be supported on a coffee pot of ordinary construction without changing the latter in the least. A further object is to provide an adjustable support which may be applied to pots of different sizes.

CUSPIDOR.—J. H. Gregory and F. M. Shumway, Farwell, Mich. The invention has in view a cuspidor having side portions hinged at the top to swing outwardly from the base and provided with a hopper bottom inclining from the center toward each hinged side portion, to insure ready discharge and easy cleansing.

Machines and Mechanical Devices.

MECHANISM FOR THE PRODUCTION OF A CONSTANT MIXTURE OF GAS AND AIR.—F. W. Wolff, 23 Melanchthonstrasse, Berlin, Germany. This mechanism is for use for the production of a constant mixture for illuminating purposes with the employment of a suction and forcing apparatus, the action of which is regulated in dependence upon the consumption, and which produces and sucks the mixture at low pressure and sends it at an increased pressure into the service pipe.

PHONOGRAPHIC REPRODUCER.—R. B. Smith, New York, N. Y. Primarily the invention pertains to phonographic reproducers, but may also be used in connection with phonographic records and generally in all relations where there is a stylus lever controllable by, or employed for the purpose of controlling a diaphragm in order to record or reproduce sounds.

DISPENSING MACHINE.—C. M. Jewell, Canastota, S. D. This machine is particularly adapted for dispensing sheets, envelops, pictures, cards, packages of cards, or similar sheet material, and relates more particularly to the operating and controlling means for delivering the articles to be dispensed to the discharge opening.

COMBINATION HARNESS AND WARP STOP-MOTION.—H. Annis and M. J. Marsh, Philipsburg, N. J. The invention refers to looms and provides motion arranged to stop the loom in case a warp thread breaks, the breaking of a warp thread allowing its heddle to drop and close an electric circuit at the time the heddle frame moves into lowermost position, the electric circuit controlling an actuating device for the usual stop motion of the loom.

DOGGING DEVICE.—O. M. Karns, Memphis, Tenn. The logs being sawed are secured by dogs to knees adjustable upon head blocks. After each cut these knees are advanced on the head blocks so as to present the log to the saw to saw another plank. The log is held to the knees by dogs. The dogs used in practice do not hold the logs rigidly on the carriage and are apt to become dislodged. The object here is to provide a device which will enable the logs to be securely held against the knees.

Musical Devices.

SELF PLAYING PIANO.—F. B. Long and E. A. Tappe, Los Angeles, Cal. The intention here is to provide an effective connection between the pneumatic and the hammer action to allow playing the piano automatically or by hand power and without interference by the connection. This is obtained by use of a lever, connected at one end with the movable member of the pneumatic, and an auxiliary lifter rod for engagement with one of the members of the hammer action to lift the rod resting on the free end of the lever.

SOUNDING BOARD FOR PIANOS.—F. B. Long, Los Angeles, Cal. In this patent the purpose of the inventor is to provide a new and improved sounding board for pianos, provided with manually adjustable devices for maintaining the original crown of the sounding board and for increasing the singing quality and the volume of the tone.

Prime Movers and Their Accessories.

BELT GUIDE.—G. H. Tinlas, Sherman, N. Y. The invention relates to belt guides, the more particular purpose being to provide an efficient form of belt guide for use in connection with portable engines and including means whereby in a few minutes, various adjustments may be made relative to the position occupied by the moving belt.

Railways and Their Accessories.

RAILROAD-TIE AND RAIL-FASTENER.—J. P. Donovan, Georgetown, Ky. This tie is provided with rail-seats which serve to prevent lateral movement of the rails, and the improved rail fastener prevents vertical separation of the rails from the ties. Thus the fastener coacts with the ties in holding the rails secured against both integral and vertical movement of the rails relative to the ties.

CONCRETE RAILWAY TIE.—J. P. Donovan, Georgetown, Ky. The invention comprises a tie with raised shoulders on the upper side which are separated to provide rail seats, and with transverse openings below the seats, for receiving rail fastenings, and reinforcing members arranged longitudinally of the tie in two horizontal sets, one near the base, the other near the top of the tie, and comprising metallic rods having end disks wholly imbedded in the concrete.

APPARATUS FOR MOLDING CONCRETE RAILWAY TIES.—J. P. Donovan, Georgetown, Ky. Mr. Donovan's invention is embodied in a box-like body or mold proper provided with certain accessories whereby concrete railway ties, also fence posts, building blocks, and the like may be produced with facility and despatch. Ten molds may be used for each shift so that concrete may take initial set in the first of the series while concrete is being placed in the last.

Pertaining to Vehicles.

VEHICLE-WHEEL.—J. H. Scott, Jersey City, N. J. This is an improvement in wheels in which a resilient connection between the spokes and the rim of the wheel is effected in order that the use of pneumatic or cushioned tires may be unnecessary. To this end a wheel is provided, a hub having a series of radiating spokes secured thereto, a rim, and a cap fitting over the outer end of each spoke having a curved spring attached intermediate its length, with its free ends connected to the rim.

ATTACHMENT FOR AUTOMOBILES.—H. S. Delamere, Ferndale, Cal. The aim here is to provide an attachment for automobiles by means of which one or both of the driving wheels will actuate a removable drum upon which a line can be wound up, to draw the automobile out of a mud hole or sand pit, and up steep grades or hills.

WHEEL.—A. C. Gillam, Hicksville, Ohio. The object here is to provide a pneumatic wheel with a punctureless tire. The annular pneumatic tubes are protected from injury being housed in by an inner ring and body plates and are subject only to pressure strain and not to frictional wear. This permits the inventor to make the air chambers of the pneumatic cushioning tubes relatively large, it being understood that these tubes may be made of any suitable material.

Designs.

DESIGN FOR WINDOW SHADES AND THE LIKE.—A. A. Boeck, New York, N. Y. Mr. Boeck has designed ornamental patterns for fabric for window shades of three different types which display artistic and original taste and form of varied and beautiful effects.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

The Poe Cult and Other Poe Papers. By Eugene Didier. New York: Broadway Publishing Company, 1909. 16mo., 301 pp. Price, $1.15.

The twenty-three separate articles comprised in this volume have been published in various American magazines during the last thirty-five years. Among the subjects treated are "The Poe Cult," "Poe: Real and Reputed," "The Boyhood of Edgar A. Poe," "Poe's Female Friends," "The Loves of Edgar A. Poe," "The True Story of Poe's Death," "The Poe Monument," "Portraits of Poe," "The Poe Mania," "The Truth about Edgar A. Poe," "Recollections of Poe by the Witnesses of His Life," "The 'Discoverer' of Poe," "Poe and the University of Virginia," "The Centennial of the Birth of Edgar A. Poe." The book is a very interesting one, and reflects great credit upon the author and shows an extraordinary grasp of the whole subject of Poe.

The Solicitor's Patent Practice. By George Frederick Emery. London: Effingham Wilson, 1909. 16mo., 245 pp.

The aim of this book is to provide a handbook for ready references on British patent law for the use of solicitors, it not being the purpose of the author to include subjects which would make it of particular value to the patent agent. Much general information is contained in the book, but it is of course impossible for the author in a little over two hundred pages to treat fully the many questions in patent law which a solicitor must be informed concerning, and on the principle that a little knowledge is dangerous it would not be wise for a solicitor to place the volume on his shelf except with more comprehensive works. When referred to in connection with some standard work "The Solicitor's Patent Practice" should prove useful.

Statics by Algebraic and Graphic Methods. By L. J. Johnson. New York: John Wiley & Sons, 1909. 8vo., 170 pp., 13 plates. Price, $2.

The former edition of this work is so well known as one of the first treatises on statics to include in a complete and practical way the valuable graphical method that it is only necessary now to remark upon the additions and alterations. These include a detailed scheme tested by the author in his classes, for assigning individual data for the exercises and a copious collection of practice problems with answers. A short syllabus is also added to facilitate review and enforce certain points. The author's arrangement is well calculated to give a facility in applying the subject valuable in engineering practice.

Strength of Materials. By Arthur Morley, M.Sc. London and New York: Longmans, Green & Co., 1909. 8vo., 480 pp., fully illustrated with diagrams. Price, $2.50.

This book, like the foregoing, is intended primarily for engineering students and differs from other works on the subject principally in the completeness with which demonstrations involving even simple mathematical problems are worked out. In many books the method is indicated and a good deal then left to the imagination, which is sometimes confusing to those whose mathematics are limited or out of practice. The result of important recent research work bearing on strength of materials has been included, reference being given to more complete records of the tests. Other important subjects are more fully treated than usual, such as the strength of rotating disks and cylinders, the bending of curved bars with application to hooks, links, etc., and the stresses and instability arising from certain speeds in running machinery, all of which are of practical application and valuable to the engineering practitioner.

Robert Fulton and the Clermont. The Authoritative Story of Robert Fulton's Early Experiments, Personal Effects, and Historic Achievements. Containing Many of Fulton's Hitherto Unpublished Letters, Drawings, and Pictures. By Alice Crary Sutcliffe. New York: The Century Company. Pp. xv, 367, 8vo., cloth. Price, $1.20.

Among the many lives of Fulton which have been written, this by his great-granddaughter is unique, because of the many hitherto unpublished letters of Fulton which it contains: letters which throw much new light on the work and aims of that distinguished man. It also contains reproductions of several drawings, which are of great interest and even future value in establishing certain disputed facts about the engines of the "Clermont."

These drawings are from four folios of Fulton's original drawings now in the New Jersey Historical Society's possession. The work throws much light upon the nineteen years which Fulton spent in Europe, and it brings us into intimate touch with the personal life and the private character of the inventor. Judged from the standpoint of strict originality, we consider that Fulton's work in the development of submarines and submarine mining was far superior to his work in the development of the steam boat, a fact which the letters published in this book and in various magazines of the past few months abundantly substantiate. The book is a most valuable contribution to historical engineering literature.

The Printing Art. Edited by Henry Lewis Johnson. Vol XIII. March, 1909—August, 1909. Cambridge, Mass. The University Press, 1909. 4to., 376 pp.

The Printing Art is one of the most welcome visitors to the Editor's table, bringing as it does the very essence of good typography reproduced in concrete and useful form. There is hardly a mechanical process which is not adequately represented in the beautiful volume before us. The Printing Art has done more for American typography than anything else which this century has produced so far. Each number is filled with actual examples of properly printed illustrations and text. The latter is of the very best and the illustrations are largely taken from work which has been actually executed and is therefore of double value. In the bound volume before us all the advertisements including the cover are bound in. This is a very wise precaution. We do not see how anyone who is binding this beautiful publication would 'strip it' as a great deal of the practical value of the book is in the advertisements and inserts. There is no bad printer that this book will not improve and there is no good printer who cannot be assisted by it. The printing art is young and the time is not far distant when the public taste will actually demand the very highest resources of plate making and printing, and this publication will go a long way toward furnishing a clearing house for the dissemination of fairly up-to-date ideas. We cannot comment too favorably on some of the examples of job printing particularly the programme title pages, many of which are superb. We shall preserve this volume for reference with a good deal of pleasure.

Sheet Metal Work. By William Neubecker. Chicago: American School of Correspondence, 1909. Large 8vo., 270 pp., fully illustrated with diagrams. Price, $3.

This is one of the best publications of the American Correspondence School that we have seen for some time. The author is evidently a thoroughly practical workman but from his experience as a teacher has more facility for telling what he knows than most good workmen possess. His explanation of the methods adopted especially in laying out patterns is thoroughly practical and clear. Just as much elementary descriptive geometry is included as is necessary for the understanding of the underlying principles, but no apprentice who desires to improve himself need be alarmed by that term if he knows nothing of the subject as it is given in a disguised and practical form on the lines of "reading without tears." Methods are given for the layout of every conceivable form of sheet metal from simple stove-pipe bends, joints and changes of diameter to the most ornate cornice work and we cannot imagine a workman being confronted with a problem to which he cannot find an analogy in this book. The form of the book is homologous as to printing and binding with the School's library and contains the usual foreword with no particular reference to this volume, but the diagrams are more than usually limited to those essential and applicable to the text.

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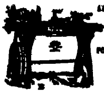

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Scientific American Supplement 997 contains an article by Spencer Newberry in which practical notes on the proper preparation of concrete are given.

Scientific American Supplements 1568 and 1569 present a helpful account of the making of concrete blocks by Spencer Newberry.

Scientific American Supplement 1534 gives a critical review of the engineering value of reinforced concrete.

Scientific American Supplements 1547 and 1548 give a resume in which the various systems of reinforced concrete construction are discussed and illustrated.

Scientific American Supplement 1564 contains an article by Lewis A. Hicks, in which the merits and defects of reinforced concrete are analyzed.

Scientific American Supplement 1551 contains the principles of reinforced concrete with some practical illustrations by Walter Loring Webb.

Scientific American Supplement 1573 contains an article by Louis H. Gibson on the principles of success in concrete block manufacture, illustrated.

Scientific American Supplement 1574 discusses steel for reinforced concrete.

Scientific American Supplements 1575, 1576, and 1577 contain a paper by Philip L. Wormley, Jr., on cement mortar and concrete, their preparation and use for farm purposes. The paper exhaustively discusses the making of mortar and concrete, depositing of concrete, facing concrete, wood forms, concrete sidewalks, details of construction of reinforced concrete posts.

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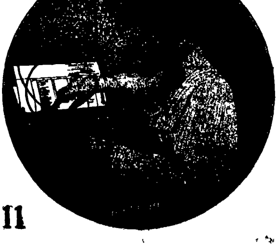

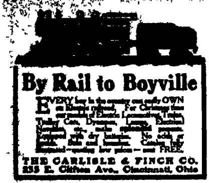

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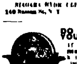

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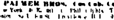

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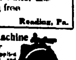

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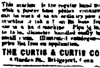

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SCIENTIFIC AMERICAN

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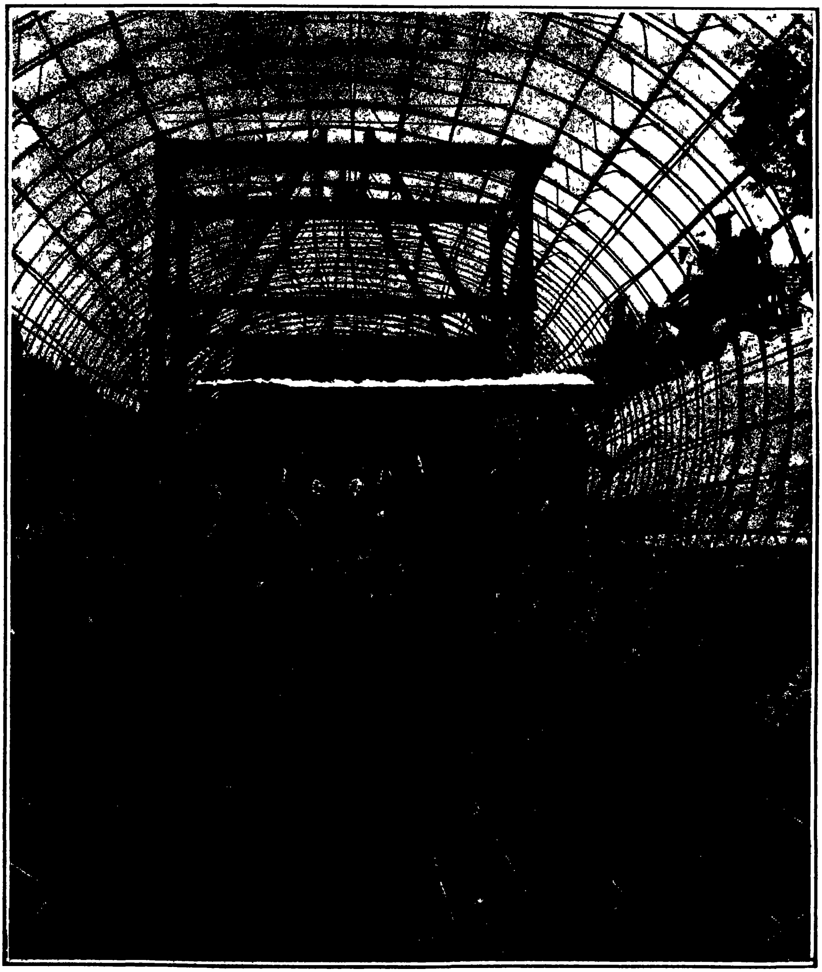

LOOKING THROUGH A REINFORCED CONCRETE CONDUIT IN COURSE OF CONSTRUCTION.—[See page 328.]

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NEW YORK, SATURDAY, NOVEMBER 6th 1909

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short* and the facts *authentic* the contributions will receive special attention Accepted articles will be paid for at regular space rates

THE AMERICA'S CUP

Securely locked away in some safe deposit vault in this city is a curious old silver cup which shows in *the fantastic crudity of its design all the earmarks* of that Victorian age in which it was fashioned Its cash value is stated to be five hundred dollars, which may be taken to be its probable value if melted up for the silver that is in it Of no worth as an object of art the cup is to-day probably the best known, as it was once the most eagerly sought-after prize in the world of international sport Won over half a century ago by the epoch making schooner "America," it has been the object of most strenuous competition and has caused the expenditure of millions of dollars by yachtsmen on both sides of the Atlantic With a persistency which is characteristic of the race, the British have sailed yacht after yacht over the ocean, in the hope of taking the 'America's" cup back to English waters and transferring the scene of future contests to those shores off which the America' won her famous victory

The effect of the America" cup contests on the development of the sailing yacht particularly in the later years has been to produce a craft of such extreme proportions—vast sail spread fragile hull and spars and excessive draft—as to render her useless for ordinary cruising and fit only for the marine 'graveyard' and the junk pile Truly a most amazing statement, but fully guaranteed by the fact that during the past decade no less than six challengers and defenders for the cup, costing altogether probably not less than a million and a half dollars have been broken up and sold for old metal.

As far as the records of this half century of contests go, they have consisted of an unbroken string of victories for the American yacht and the British must get what consolation they can out of the fact that the American designers, in their efforts to hold the cup, have had to forego the characteristic centerboard hull and sloop rig and come over to the English deep-keel and the cutter rig. The successive defeats of recent years have convinced the English yacht designers that they must abandon all hope of outbuilding and outsailing the American defending yacht so long at least as there is no restriction upon lightness of hull and size of sail spread

Some years ago our own yachtsmen and those of France Germany and England came to the conclusion that the time was ripe for making such changes in the rules of measurement as would modify or control, those extremes of construction which have rendered the racing yacht an unseaworthy, unwieldy and outrageously expensive craft to build and maintain in commission Both here and abroad new rules have been adopted which have resulted in the production of yachts that are in average weather as fast as the freak boats and at the same time are suited for the average summer cruising Sir Thomas Lipton the most persistent of all contestants for the America's cup has been told by the English designers that they are unable to build a yacht under the old rule for which they can give an assurance of any likelihood of success in the contests off Sandy Hook They claim that a boat built of sufficient staunchness to take the chances of a stormy Atlantic crossing can not compete with a craft which during her season's sailing never has to venture out of sight of land, and does most of her racing in the sheltered waters of Long Island Sound and within a few hours' sail of the yard in which she was built. To this the reply has been made that, since the English yacht is towed across, carrying a reduced rig, the danger of her foundering in heavy weather is eliminated

The writer once put it squarely to Mr William Fife, designer of two of the challengers whether he considered the ocean crossing to be a handicap After a few moments thought he replied "Theoretically no, but actually, yes, and this for the reason that, however keen a yacht designer may be in his desire to cut down weights his humanitarian instincts will remind him that the lives of over a score of men are to be committed to that shell, to take the chances of a three weeks' crossing of the Atlantic" Be that as it may the fact remains that the British have frankly acknowledged themselves beaten under the present rules, in contests between yachts of unrestricted lightness and Sir Thomas Lipton is in our midst to-day requesting that the New York Yacht Club sanction an America" cup contest under their own new rule, under which for some years their regattas have been held

The New York Yacht Club contends that, since the America" cup stands for the fastest yacht that can be built, and since it has been proved that the fastest yacht can be built under the old rule, therefore for 'America" cup contests the old rule is the proper one to sail under—and there can be no doubt that technically the attitude of the Club is correct. At the same time we believe that under the present Deed of Gift the challengers and defenders may mutually agree to make certain changes in conditions if they so wish All the same we would suggest that, since racing for the America cup under existing conditions is at an end, and since after all the cup is merely an emblem of the sport and it is the sport and not the cup that is the ultimate object of yacht racing it might be as well to make a sufficient modification of the old rule to encourage the yachtsman not merely of Great Britain but of that other great yachting nation Germany to make a try for the famous old trophy.

DOVER'S GREAT ARTIFICIAL HARBOR.

The opening of Dover naval port marks the completion of the greatest artificial harbor ever built entirely in the open sea. The scheme includes an extension of the Admiralty pier for two thousand feet, the formation of reclamation works for the protection of the shore at the eastern end of Dover town, extending in the direction of St. Margaret's Bay for three thousand nine hundred feet, a protecting arm extending from the eastern end of the reclamation for a distance of two thousand nine hundred feet into the open sea, and an island breakwater approximately parallel with the shore line end extending from the end of the Admiralty pier extension on the west to the end of the easterly pier already referred to, with wide entrance openings between the heads of the several breakwaters If we include the eighty acres which constitute the present commercial harbor there is inclosed by these works a total area at low water of six hundred and ninety acres of deep-water harbor capable of floating the largest of modern battleships and ocean liners. This is the largest area of the open sea ever inclosed by solid masonry protecting works.

Although that portion of the inclosing breakwaters which is visible at high water gives an impression of their great length and of the wide extent of the harbor, it is a fact that the visible masonry represents only a small proportion of the work actually done The total length of the sea works is two and a half miles two miles of which are in exceptionally deep water Thus, the two-thousand foot extension of the Admiralty pier measures from the top of the parapet to the foundation nearly one hundred feet in height and the eastern pier has a total height above foundations of eighty-seven feet The total width at the base of the piers is over fifty feet and at the top forty seven feet six inches

It is an interesting historical fact that it was Sir Walter Raleigh who first drew attention to the strategical and commercial importance of Dover, speaking of it as "situated on a promontory next fronting a puissant foreign king and in the very straight passage and intercourse of almost all the shipping in Christendom' It was as far back as the year 1840 that a Royal Commission recommended a scheme of harbor construction at a cost of ten million dollars Out of the deliberations of this and subsequent commissions came the decision to construct the Admiralty Pier, so well known to Americans who visit or return from the Continent by way of England for which a contract was let in 1847, but which did not reach completion until twenty years later It was not until the year 1895 that the plans for the present fine harbor took definite shape, the contract was let in 1897, and active construction commenced shortly afterward The fears which have been expressed that this, like other harbors won from the open sea, might be subjected to shoaling up by drifting sands have not been verified, the depth remaining practically constant.

IMPROVEMENTS IN NEW YORK'S HIGH-PRESSURE FIRE SERVICE.

A recent order of the New York Fire Department relieves the fire engines of the various companies in the district protected by the high-pressure water service from responding to alarms of fires, and may be considered as a practical and official indorsement of the complete success of the system. Soon after the high-pressure was installed the right of way in going to a fire was given to the hose wagons over the engines, and while the latter answered alarms they were held in reserve or used merely for washing down after the high-pressure lines had extinguished the fire.

The successful and intelligent use of the high-pressure by the Fire Department was accompanied by a careful study of the actual workings of the system by the engineers of the water department with a view to detecting any possible defects. As a result the new extension, now beginning to be installed and aggregating some twenty-one miles of mains, represents a marked improvement over the part at present in use, which, as the largest and most complete plant of the kind, is serving as a model for other cities The most important improvement is a duplicate arrangement of mains so that in case of a break or other failure one-half of the system can be cut out immediately without impairing the efficiency of the other half in any way This is secured by gridironing the territory with two independent systems whose mains are laid in alternate streets. Thus in the case of a break in a main supplying a hydrant on a certain street, that half of the system to which it belongs can be shut off at once and the firemen only have to stretch their hose from a hydrant connected with the other set of mains usually *to be found on the next street.* The two systems and their hydrants, which will probably be painted a different color or otherwise marked, are so arranged that a hydrant of the second system is never over 500 feet from any given point, just as under normal working conditions there is a hydrant within at least 200 feet of any possible fire

The desirability of such an arrangement was apparent to the water department engineers at a fire on December 16th, 1908 at Grand and Mulberry Streets, when the high pressure service had its only failure and was temporarily out of service. This was due to a break caused by the giving way of a temporary end of a main in an excavation for the Centre Street subway where the supports for the main had been cut away by the subway contractors

While it is possible to locate and cut out any section where a break occurs by means of valves located at street intersections, yet this process may require considerable valuable time when the water is seriously needed at the fire. The valves themselves are ponderous affairs moved by hand and to close the two three, or four required to cut out a broken section may consume from twenty minutes to half an hour Accordingly after studies by the engineering staff of the high pressure division of the water department it was decided to install an independent system of two mains as outlined.

Normally, both systems will intercommunicate and connect with the present system so that there will be a complete circulation of water, supplied at any desired pressure from the pumping stations at Gansevoort and West Streets and at Oliver Street and East River Now, in case of a sudden break the gage at the Oliver Street station connected with the outlet of the half of the system involved will be immediately apparent and that portion can be shut off at the station This is accomplished by closing the appropriate valves on the outlets at the station and two distant controlled valves at the Bowery and Houston Street or at New Chambers and Cherry Streets, depending on the part involved All of these valves are electrically worked and can be operated simultaneously so that one system or the other can be isolated in less than a minute. This increased measure of safety, the importance of which cannot be overestimated, is rendered desirable not through any inherent defect in the high-pressure system but largely on account of the conditions under which it must be installed and operated in a city like New York, where frequent excavations and gas explosions are likely to damage the mains or produce weakness that only service conditions may develop. If the break is detected in season it is of course possible to isolate the crippled section and notify the firemen accordingly, but failure in service is a serious matter which the new duplex system will render much less dangerous.

Few pieces of municipal engineering have been better planned, constructed and operated than New York's high-pressure service, and that it is capable of still further improvement would indicate that, when this form of fire protection is provided for the entire city it will eliminate the possibility of a large conflagration, which Chief Croker states is no longer to be feared in their present protected district. Further extensions besides the one under way are contemplated in the near future, and additional pumps will be installed.

[illegible] the halfway [illegible] job of excavation [illegible] By that time 97,172,954 cubic [illegible] about one-half of the total excavation, had [illegible] removed. The grand total for September was [illegible] cubic yards, which is 1,042,952 cubic yards less than the highest record, which was made in March, 1909.

The State Department has been informed that the President of Guatemala has directed a bronze bust of Robert Fulton to be placed in Estrada Cabrera Park in Guatemala city in recognition of Fulton's genius. The government of the United States has directed the American Minister at Guatemala city to express its appreciation to the Guatemalan government for the honor thus done to the memory of a distinguished American.

The Commissioner of Patents has decided in favor of Commander Cleland Davis, U. S. N., in the interference proceedings that have been pending for many months past against his application for patent on his projectile-carrying torpedo. One witness testified that in the spring of 1903 Davis drew a diagram of his device upon a napkin and explained that his idea was to insert in a torpedo a gun which would discharge a high explosive shell through the armored bottom of a ship and enable it to explode within the vessel.

The inauguration of railway travel through the tubes of the Pennsylvania Railroad Company between New Jersey and Long Island took place recently without any demonstration and under very prosaic conditions. The first trip was made by a train of dump cars hauled by an ordinary switch engine, which passed from Jersey City beneath the North River, Manhattan Island and the East River to Long Island City The formal opening of this great work will probably take place within the next few months.

According to a dispatch from Quebec, the Harland & Wolff shipbuilding firm of Belfast, Ireland, working in conjunction with the Canadian Pacific Railway, have acquired a large area of land at Levis, at which dry-dock, ship repairing, and building plants will be built this spring for the purpose of building Canada's navy. Sir Thomas Shaughnessey, president of the Canadian Pacific Railway, refuses to discuss the rumor It is said that he personally conducted the negotiations between the shipbuilders and the government.

The largest scrap heap in the world is in San Francisco, a relic of the great fire which followed the earthquake of April, 1906. It is 40 feet high, 100 feet square and contains 20,000 tons, all cut in equal lengths of eighteen inches, and piled in one solid mass, with the sides as plumb and true as a brick wall This is the only one of four heaps of equal size and proportions which remains intact in its original size and shape, the other three having been drawn upon as the material was needed.

An extraordinary accident happened at Durban, South Africa, to an immense traveling coal unloader, mounted on four trucks and traveling on two pairs of standard-gage rails 80 feet apart, which can pick up and dump an ordinary railroad car full of coal. It was blown along the track by a gale until it left the metals, when in spite of the stability due to its large wheel base as compared with its height, it fell over on its side. As it has booms 190 feet long and is nearly 100 feet high, the task of re-erecting it calls for considerable ingenuity

That the submarine bell is valuable in preventing delay of ocean liners by fog has recently been proved in the case of the "Lucania" and the "Kaiser Wilhelm der Grosse." The former vessel, while approaching New York, was enabled to make the light vessel by submarine bell signals, these being her sole guide The captain of the "Kaiser Wilhelm der Grosse" when on his eastern passage was shut in by dense fog near Fire Island light vessel. He was able to hear the submarine bell and direct his course accordingly, although, as it subsequently transpired, he was twelve nautical miles distant from the signal station. It is significant that at the same time the fog horn of the lightship was quite inaudible.

A breakwater which, when completed, will be some [illegible] feet in length, is now in course of construction at Hilo, in the Island of Hawaii, to protect shipping from the heavy seas that sweep from the northeast. At present some 400 feet have been completed, and under the existing contract it is estimated that by the middle of next year a length of some 3,000 feet will be in position. The material used for construction is a basalt rock resembling heavy granite, which is quarried some 15 miles away, and transported to the works under contract with the Hilo Railway Company According to the specifications, from a depth of 3 feet below the water-line to the top, bowlders of not less than [illegible] tons in weight are to be used. The contractors [illegible] that the work is [illegible], which weighs [illegible] without the use of cement. [illegible]

ELECTRICITY.

The chief engineer of the British Post Office Department, Major Walter O'Meara, is visiting this country for the purpose of studying our telephone systems. The British government is to take charge of the entire telephone system of Great Britain in 1911. It will be operated as is the telegraph system, by the Post Office Department.

The contract has just been let for the huge dam across the Conchos River in Mexico. This dam will form a reservoir of 1,840,000,000 cubic meters capacity. The hydro-electric plant which will obtain power from this source has a capacity of 25,000 horse-power, which will be used at a number of large mines within two hundred miles of the generating station.

An electric railway has just been completed running from Ville Franche to Bourg-Madame The line is thirty-four miles long and it has a schedule of three trains a day in each direction. Starting from Ville Franche at 1,407 feet above the sea the line rises to 5,220 feet and then drops to 3,750 feet at Bourg Madame. The motor cars are each equipped with four 50-horse-power motors. The third rail system is used and energy is supplied at about 800 volts.

A circular has just been issued by the Bureau of Standards discussing electrical measuring instruments in general, describing the various types of instruments, pointing to the sources of error and explaining methods of checking them. The Bureau undertakes to test any instruments sent to it for this purpose, making a small charge for the work involved The circular contains the regulations governing these tests, and a schedule of the fees charged

The city of Liverpool is at present experimenting with flaming arcs and tungsten lamps for street lighting. A row of flaming arcs is set on posts in the middle of one of the principal streets The arcs are 20 feet above the ground, and 10 feet below each is a circle of 25-watt tungsten lamps. At midnight the arc lamps are extinguished and the filament lamps are used in place of them. On one of the narrower streets clusters of tungsten lamps are hung over the center of the street from wires strung across from the buildings at opposite sides, thus avoiding the use of poles

A series of lectures has been given before the Fire Insurance Club of Chicago by Mr B E. Blanchard, who is the Chief Electrical Inspector of the Chicago Board of Underwriters. The subjects so far discussed are "Electricity," "The Electrical Inspector" "Outside Work—Systems and Voltages," and "Inside Work' The remaining two lectures will deal with 'Low Potential Systems" and "High Potential Systems" These lectures have been found very instructive because the subjects are explained in simple non technical language, so that the insurance men readily understand them

The Committee on Units and Symbols of the German Association of Electrical Engineers has just published a report suggesting uniform symbols for alternating-current units. There has been some criticism of these recommendations, because the letters used represent German words and differ materially from the symbols common in other countries. While standardizing of symbols is to be highly recommended, it is pointed out that the symbols should be such that they may be adopted by other countries as well so that eventually we can have an international set of standard symbols and thus avoid some of the confusion that now exists in electrical literature

Evidently carbon filament lamps are still receiving considerable attention in England. Two patents have recently been issued on the subject, one aiming to regenerate the filament, and the other to prevent the blackening of the glass bulb. In the first case the bulb is opened, and after being cleaned hydrocarbon is introduced. Then on heating the lamp the hydrocarbon is decomposed and the carbon is deposited on the filament. In the second case the inventor believes that the blackening of the glass may be obviated by removing the mercury vapor which enters therein while the bulb is being evacuated. Therefore he proposes to coat the stem which holds the filament with silver, so as to absorb the mercury vapor

A recent article in the Electrical World contains the following data relative to the utilization of the energy from Niagara Falls. Of the 5,000,000 horse-power represented by Niagara Falls, only about 5 5 per cent is being utilized. Of this, 126,800 horse-power is employed in electro-chemical processes, 56,200 horse-power for railway service, 26,400 horse-power for lighting, 45,640 horse-power for various industrial services, 12,200 horse-power is transmitted over more than one hundred miles, 35,566 horse-power between seventy-five miles and one hundred miles, 3,100 horse-power fifty miles, 78,840 horse-power between ten and thirty miles, while 145,400 horse-power is used locally, showing that many industries have been attracted to Niagara Falls because of the favorable electric power conditions to be found there.

SCIENCE.

Halley's comet appears to be growing brighter somewhat rapidly It was seen without difficulty at Harvard on October 17th by Prof. Wendell with the 15-inch equatorial, and by Mr L. Campbell with the 24-inch reflector

Leon Guillet's and Ch. Griffiths's experiments on the cementation of iron by pure carbon show there is no cementation if precautions are taken to prevent the presence of gases, but it takes place if contact is insured Moreover, it increases with the pressure, but always occurs extremely slowly

The American Machinist states that the methods of race-track gamblers, who dope horses in order to make them win races, have been copied by unscrupulous owners of gasoline racing boats The gasoline is doped with picric acid or some other high explosive, and with the increased power thus obtained the boats are able to win races they would lose if ordinary straight gasoline were used On the race track there are stories of plugs which have been overdoped and died and it is said there are also gasoline engines which have been unable to withstand an overdose of picric acid and have gone heavenward

Samples of air at a height of nearly nine miles have been recently obtained and examined for the presence of the rare gases. The collecting apparatus, carried by a large balloon is a series of vacuum tubes each drawn out to a fine point at one end At the desired height an electro-magnetic device, connected with each tube and operated by a barometer, breaks off the point of the tube admitting the air A few minutes later a second contact sends a current through a platinum wire around the broken end, melting the glass and sealing the tube All the samples obtained show argon and neon but no helium was found in air from above six miles

A 40-inch mirror is almost completed by Clark for Prof Percival Lowell at Flagstaff, Arizona. The mirror is to be thicker than usual to avoid flexure and is to have a focal length of 18 feet 4 inches. A series of zinc blocks between the iron supporting ring and the edge of the mirror avoid strains on the glass with changes of temperature When arranged for planetary work, secondary mirrors are to be provided which will transform the instrument into a Cassegrainian reflector of either 154 feet or 75 feet focal length. For photographing nebulæ and stars a plane mirror will be used as secondary giving the images at the principal focus

Harvard College Observatory issues a bulletin stating that Prof E E Barnard of the Yerkes Observatory obtained visual observations of Halley's comet on the 17th and 19th of October On these two dates Prof Barnard found that the comet was not fainter than the 13¼ magnitude, having a diameter of 15 seconds, and while it exhibited no elongation, it was 'less indefinite and brightening in the middle" In summarizing the late European observations of Halley's comet Nature points out that the date of the comet's perihelion passage must be advanced 3 4 days, thereby making it April 20, 1910 The comet is at present distant about two hundred and eighty million miles from the sun and two hundred and thirty million miles from the earth

A French investigator M de Wegrier recently described an apparatus designed to prevent the formation of hail. A similar apparatus was invented by Beckensteiner fifty years ago and was described under the name 'géomagnetifére" in his Etude sur l Electricite' To the top of a pole about 65 feet high made of the trunk of a resinous tree and painted with oil in order to make it a non-conductor was attached a mass of gilded copper with five points connected to earth by a magnetized (?) galvanized iron wire The apparatus also included a large metallic net or grating, buried in the earth Dr Frestier has repeated and extended Beckensteiner's experiments and has obtained conclusive proof of the efficacy of the apparatus as a preventive of hail

The method of forcing plants by treatment with ether, as first suggested by Johannsen is now extensively used on a commercial scale for the purpose of securing out-of-season flowers and fruit This process, however, will in all probability soon be replaced by the equally effective and less expensive method just described by Prof Molisch in a pamphlet called "Das Warmbad" The only treatment required is that of immersing the shoots, by inversion, in water at 30 to 35 deg. C, for nine or twelve hours, and afterward keeping the plants in a dark moist chamber at a temperature of about 25 deg. until the leaves commence to appear, after which the plants are grown under ordinary greenhouse conditions. Lilacs, azaleas spiræas, etc, treated as above during the middle of November were in bloom at Christmas or early in January, whereas untreated plants of the same kind had not commenced to move. Fuller methods of treatment and the duration and temperature of the bath for different kinds of plants, are contained in the pamphlet.

A REMARKABLE MEXICAN CONCRETE CONDUIT AT GUADALAJARA.

BY FRANK C. PERKINS.

In the Rio San Juan Ravine, which passes through the heart of the city of Guadalajara in Mexico, a circular concrete conduit has been constructed to serve as a storm water drain. This reinforced concrete conduit is of novel construction; and on account of its design and size is of special interest. It is somewhat over 13 feet in diameter and is circular in form for most of its length, the upstream section, however being flattened in order to avoid a large amount of excavation in rock.

This Mexican concrete conduit is nearly a mile in length. It passes to one side of the center of the city for about a mile, and drains nearly 17,000 acres. It has a grade of 4 feet per thousand feet, and has a thickness of 10 inches of concrete, reinforced by double rings or round corrugated bars. These bars are placed one foot apart longitudinally, in two circles, the inner and outer bars alternately The bars each measure one-half inch in diameter

It is stated that the total concrete in the conduit measures 13 000 cubic yards, the steel used for reinforcing weighing 300 000 pounds. In the construction of this conduit, 40 per cent of river sand was utilized and 60 per cent of sand made from crushed rock. Three parts of this sand are used with three of crushed rock and one of cement, the latter being of the Hidalgo brand, made at Monterey, Nuevo Leon, which is said to be about the only factory producing Portland cement in Mexico.

One of the accompanying illustrations shows a portion of the completed conduit and the moving of the high exterior forms by means of traveling gallows frames. This system of molds and the apparatus for shifting them is simple and very efficient.

Other illustrations show the erecting of forms inside of the reinforcement which is supported on concrete blocks, as well as the method of placing the reinforcing bars in position There was a test made of the strength of the conduit about 25 feet in length when a week old by passing a roller weighing 32,000 pounds over it, and also by allowing the roller to stand upon it for 120 minutes After this severe test it was found that no crack developed, the earth filling over the top of the conduit in the test being about three feet in depth

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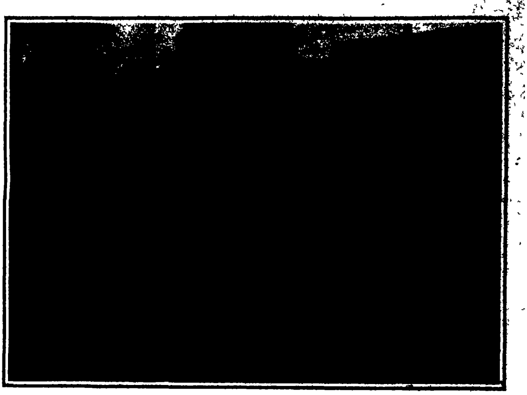
Cultivation of Edible Fungi in Forests.

In many districts of Perigord in southern France, the black truffle (*Tuber melanosporum*), the most highly-prized species is artificially propagated For this purpose the tubers are dried, cut into small pieces, mixed with water, and ground to a thin paste, small quantities of which are spread upon green hasel or oak leaves, which are buried in the earth under oak trees. The first truffles appear five or six years afterward. In Germany the black truffle is found only in the west The truffles which grow in central Germany are of inferior species, hence Prof Mayr recommends the artificial propagation of black truffles, according to the Perigord system, in the warmer parts of Germany, especially where oaks abound, as the production of truffles is dependent upon the presence of deciduous and particularly of oak forests. The mushroom also grows well in the forest, but its artificial culture is usually carried on elsewhere Experiments made by Mayr for the purpose of colonising the mushroom in localities in the forest where it does not grow naturally have met with no success, although they have been continued for five years. The attempt at colonising was made by taking up the mushrooms immediately before the ripening of the spores, and transplanting them to the desired spot, on which the spores necessarily fell. On the other hand, Schroeder, in a recent article, has described his success in transplanting the craterelle (*Craterellus sucleatus*) which in flavor is surpassed *only by the Perigord truffle. Selected spots in the forest* planted with spores of this fungus bore abundantly

In Japan, Mayr has had opportunity to observe the artificial propagation of the most delicious of all Japanese fungi, the *Agaricus shitake.* The cultivation of this fungus is the only form of forestry practised in extensive districts in Japan Young trees of various deciduous species, or boughs as big as a man's arm or leg, are cut immediately after the fall of the leaf, allowed to lie about one hundred days in the forest, and then sawn into logs three or four feet long, in which deep incisions are made The spores of the fungus, which are present everywhere in these districts, penetrate the incisions, and develop a mycelium which [illegible] The [illegible] the logs in the following autumn, [illegible] abundantly from the second to the fifth year, [illegible] both from the incisions and from the [illegible] Mayr has recommended the cultivation of the Japanese mushroom in Germany, and has made experiments by inserting bits of mushroom-bearing wood, brought from Japan, into holes bored in boughs cut from deciduous trees. The experiments proved that the beech, the hornbeam, and the birch are best suited for the culture of the fungus, but that the young cultures are greatly injured by snails, and also by the competition of native fungi.—Prometheus.



How the reinforcing members are placed in position.

◆

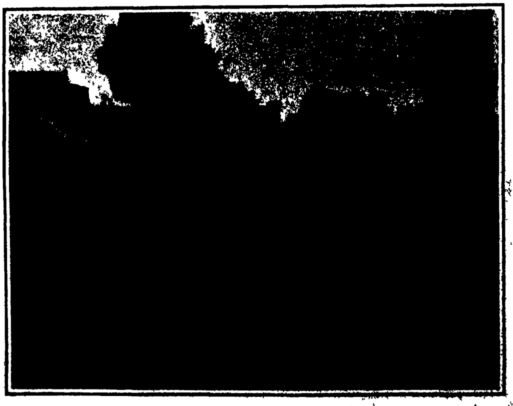
Ammonia from Atmospheric Nitrogen.

A new process for producing ammonia from atmospheric nitrogen has been developed from experiments in the synthesis of hydrocyanic acid, which were made by Waltereck and Eschweiler, of Hanover.

In these experiments, in which a dry mixture of hydrogen and nitrogen was passed over iron at a dull red heat (about 900 deg. F), a small quantity of ammonia was always formed. This result was subsequently confirmed by Sir William Ramsay Ammonia was formed only at the beginning of the reaction, but it was found that larger quantities of ammonia could be obtained by passing a mixture of air and coal gas over oxide of iron, and this result led to a series of experiments with various oxides of nickel, cobalt, copper, cadmium, silver, lead, bismuth, chromium, and iron. The most interesting results were obtained with oxides of bismuth, chromium, and iron. The oxide was inclosed at first in an ordinary combustion tube, afterward in an iron tube. The mixture of equal volumes of air and coal gas was moistened by passing through distilled water heated to 175 deg. F, as a certain quantity of moisture was found advantageous. The yield of ammonia varied greatly with the temperature, the best results being obtained between 570 and 660 deg. F.

It was observed, however, that the production of ammonia diminished as the oxidation of the iron increased, so that it was necessary to reduce the iron from time to time by passing hydrogen or carbon monoxide through the tube at a high temperature.

Experiments were then made for the purpose of finding some other sufficiently cheap substance, the oxidation of which would produce the same result, without requiring repeated reduction. Coke, wood charcoal, peat, and lignite were found to satisfy these requirements fairly well. With coke the process is very slow; much more satisfactory results are obtained with peat. One specimen of peat, containing [illegible] per cent of water and little more than 1 per cent of nitrogen, furnished 8 per cent by weight of sulphate of ammonia. In a large number of experiments made with a horizontal iron retort, such as used in the analysis of coal, [illegible] per cent of sulphate of ammonia was obtained. As this was more than the nitrogen of the peat would furnish, it was inferred that part of it must have been derived from the nitrogen of the air. This conclusion was confirmed by experiments with [illegible] which contained no nitrogen. In the [illegible] peat and other forms of carbon [illegible]



Part of the completed conduit.

A REMARKABLE MEXICAN CONCRETE CONDUIT AT GUADALAJARA.

[illegible] AT MILWAUKEE.

The scene of absolute destruction depicted in the accompanying engravings might well be supposed to represent the effects of the detonation of a large amount of high explosive so complete is the demolition of the building and so thoroughly have its contents been disrupted and scattered As a matter of fact the damage was entirely due to the explosion of a single boiler

At first sight it would seem impossible that the amount of steam contained in a boiler at the instant of explosion should be sufficient to work the seemingly disproportionate amount of damage that generally ensues—disproportionate, that is to say in the wide extent and violent effects produced as compared with the cause Everyone who is familiar with boiler firing knows how quickly the reserve of steam in the boiler is used up in the cylinders of the engine if the firing be not faithfully attended to

The explanation of the great damage resulting from an explosion is to be found in the fact that the boiling point of water varies with the temperature and the pressure to which it is subjected If the pressure be suddenly reduced a rapid ebullition of the water ensues with the emission of great volumes of steam Consequently when the whole of the pressure upon the highly heated water in a boiler is suddenly removed by the rupture of the boiler shell the whole mass flashes at once into steam with a practically explosive effect which shows itself in the lifting of roofs the blowing out of walls and the hurling as is frequently the case of the shell of the boiler to distances of several hundred yards

The boiler which exploded was one of four which were erected in one of the boiler houses at the Pabst Works Milwaukee Wis The most sensational result—the one which gives a vivid idea of the energy of the expanding steam—was the fact that a big malt elevator 60 feet high adjacent to the boiler plant was moved four feet from its foundation This effect will be noticed by examining one of the accompanying engravings in which it can be seen that the remaining portions of the wall although they are strictly parallel with each other are out of line by about the four feet which it is estimated that the building was moved

The wall of a machine shop lying to the north was blown in Every window in this machine shop and most of the glass in the buildings surrounding the plant were broken as was most of the glass in stores and houses within a radius of two blocks of the explosion Tenth Street adjoining the building was buried under tons of debris which in some places was piled to a height of from six to eight feet Flues boiler pipes and various fragments of the boiler were scattered over the street and some of them were curled up into fantastic forms

It frequently happens in a boiler explosion particularly if one end be torn off and the main body of the boiler be left intact that the water flashing suddenly into steam and rushing out through the unclosed end reacts against the air with a violent rocket like effect and the mass of the boiler is driven to great distances In the present case a large section of the boiler went hurtling through the air across Tenth Street and fell upon the roof of a storehouse sixty feet in height where it remained imbedded Strange to say a lofty brick chimney over two hundred feet high, which formed a part of the plant and stood over the rear portion of the boiler room received not the slightest damage

* * *

SOME PRINCIPLES OF BALL BEARING DESIGN

BY J F SPRINGER

The old but constantly recurring question as to whether the top of a wagon wheel actually moves faster than the bottom is really involved in the ball bearing problem There is one fundamental fact implied in all questions of rolling which when once thoroughly mastered will have great effect in clearing up dark places In rolling there is a progressive contact of one body with another of such character that there is no sliding That is to say at the point of contact there is absolutely no movement of the one body past the other In Fig 1 the wheel is rolling upon the ground *G* in the direction *C* At the present moment the point of contact is *A* If the motion is a rolling one then at the point *A* there is no slip or slide This means that the point of the wheel touching the ground at *A* has absolutely no motion But this point on the tire of the wheel enjoys this absolute rest for the instant only The next infinitesimal portion of time there is a different particle absolutely at rest And so on as the wheel rolls along every point of the circumference in succession becomes for one instant only an absolutely quiescent point What is moving is the position of the point of rest

This is true whether the rolling body rolls along a straight line or not If the line rolled upon however has any motion of its own then the contacting

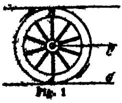


Fig 1

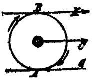


Fig 2

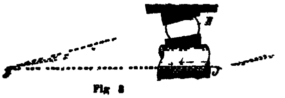


Fig 3

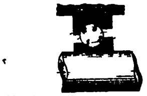


Fig 4

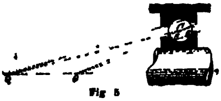


Fig 5

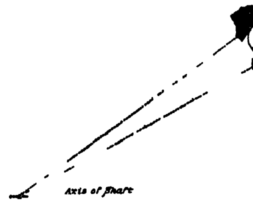


Fig 7

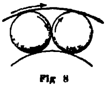
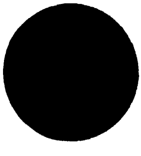


Fig 8



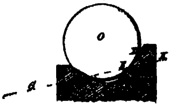


Fig 6

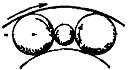
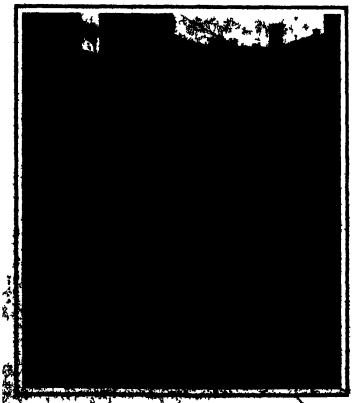


Fig 9

Fig 10

SOME PRINCIPLES OF BALL-BEARING DESIGN


[illegible] the wall of the building 60 feet high which [illegible] of 4 feet.

The debris covered this street to a depth of several feet. A large portion of the boiler was thrown across the street and landed on a roof of a 60-foot building.

[illegible] OF A TERRIFIC BOILER EXPLOSION AT MILWAUKEE.

point of the rolling body is at rest only with reference to this moving line As one stands aside and views both the contacting has precisely the same motion as the moving line But if on the moving line, then he sees the lowest point of the wheel absolutely at rest for its instant of contact.

But suppose that one takes his position at the center of the wheel The highest point of the wheel will appear to be moving forward in the direction *C* while the lowest point will seem to be moving in the opposite direction In fact, *with reference to the center* the particles of the wheel will have a movement of rotation

There are thus two rotations going on all the time. The entire rolling body rotates *for the instant of contact* about the point of contact. This center of rotation is constantly changing, however The central particle of the rolling body on the other hand, always remains a center of rotation

Further if there is a second contacting surface, as in Fig 2—this second surface effecting the driving of the circle—then *relatively to this moving surface* there is for the moment of contact a center of rotation This instantaneous center of rotation—the upper point of contact—moves backward relatively to the driving surface

Much the same may be said in reference to straight and tapered rollers in a roller bearing There is a central line consisting always of the same particles and relatively to which all the remaining particles rotate as about an axis It is the *axis of rotation* Then, diametrically opposite each other, are two lines of contact. Each of these is an instantaneous axis of rotation quiescent for the moment of contact but immediately succeeded by another Thus in Fig. 3, the line *DE* is the axis of rotation In the body of the roller, the particles of material along this axis are such that if they be regarded as quiescent, every other particle will be seen to rotate about their line of distribution The lines of contact of the roller with the race ways are the two instantaneous axes of rotation

The motion of each of the particles of the wheel Fig 1, is the compound of two distinct movements—(1) motion in a direct line given by the arrow *C* and (2) motion of the point as it rotates about the center of the wheel Both uniform we see that at *B* both motions are in the same direction, while at *A* the directions are the opposite Further, as learned, there is no motion of a particle at the moment of rolling contact So then at *A* the velocities of the contrary motions must be the same in order to produce this quiescence. We have now arrived at a most important principle—the forward velocity of a rolling body is just equal to its peripheral velocity And, further since at *B* both are in the same direction, we have the principle that the velocity of the point of the periphery furthest removed from the point of contact is just double the forward velocity So that (Fig. 2) the velocity of the driving surface *K* is double the forward velocity of the driven circle These are most important propositions, and are true whether the plane of rolling is perpendicular or inclined to the surface upon which the rolling is done.

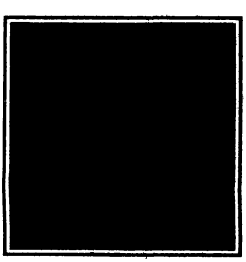
Without going into the mathematical proof it may be stated that in consequence of principles already enunciated the axis of rotation and the two instantaneous axes of rotation are three lines meeting in a point Further, if the rolling bodies are balls or rollers revolving about a shaft, then the axis of this shaft must pass through this point of intersection. Thus in Fig 3, these four lines all meeting in one point are *DH*, *DE*, *DF* *DJ*

In ball and roller bearing design, this requirement becomes of first rate importance. Thus the four-point ball bearing shown in longitudinal section in Fig. 4 is correct in design in so far as the convergence of these four lines are concerned But some may have difficulty in seeing that a rolling ball has an instantaneous axis of rotation as well as a roller Reflect, then, that both the points 1 and 2 of the ball in Fig 4 are absolutely at rest for the infinitesimal moment of contact They determine, therefore a line of quiescence equally with a roller Similarly, the points 3 and 4 are at rest relatively to the driving ball race—and determine a second instantaneous axis of rotation.

In Fig 5 the instantaneous axis of rotation determined by 5 6 intersects the axis of the shaft at *O* This gives *OC* for the axis of rotation. Similarly 7 8 yield the line *QO* as the axis of rotation We have, therefore two conflicting axes of rotation The design of the bearing is consequently incorrect

The friction arising from compression is an important matter In Fig 6 *GK* is one of the instantaneous axes of rotation The ball is flattened by compression at the points of contact, the one region of contact being represented by *FD* At the instant of contact the ball is rotating on *GK* as an axis. This means that every point along *FD* is rotating in a plane perpendicular to *GK* The result is that all along *FD* there is a sliding taking place relatively to the race way The point *D* is moving in a circle whose center is *C* and radius *DC*. There is, then, sliding friction, effective over the whole area of compression. The pressure corresponding to the slide is in the direction *GK* The seriousness of the friction, then, is dependent upon the pressure in this direction. The size of the compression is due to the pressure perpendicular to *FD* By suitably designing the race ways, the pressure in the direction *GK* may be made small, although it may be unavoidable to keep large that in the direction perpendicular to *FD* The way to do this is to diminish the angle *DBC* A design such as that shown in this figure (6) is to be condemned on account of the large size of this angle between the race way and the instantaneous axis of rotation In Fig. 7 a correct design is shown. If we observe in Fig 6 that *AHB* is an isosceles triangle, we readily see that angle *DBC* is one-half the supplement of the angle of the groove *AHB* Consequently, if we desire to make *DBC* small, we see to it that *AHB* is large Thus, by making $AHB = 170$ deg., the angles between the instantaneous axis of rotation and the faces of this race way are reduced to 5 deg. each For such angles the pressure in the direction of *GK* is well-nigh negligible This means that the sliding friction due to compression is practically eliminated

A further question that arises in designing ball and roller bearings relates to the use of separators. In Fig. 8, it will be readily seen that at the point of contact between two balls (or rollers) there is a slide, the surfaces in fact moving in opposite directions. The question arises Should balls be prevented from mutual contact so as to eliminate this source of sliding friction? To answer this it is necessary to know whether the slide occurs under pressure For despite the slide, the friction would be negligible if there is little or no pressure from ball to ball. The writer has made a very complete mathematical inquiry and found that balls and rollers probably do press upon each other with a considerable percentage of the load, so that separators are to be regarded as advisable If used, however, they should be rolling separators. The introduction of a non-rolling separator will not result in eliminating sliding friction. But by properly using a rolling body—a ball or roller—this friction may be avoided Fig 9 shows that the small separator ball is competent to partake of the contrary motions of the bearing balls.



A CURIOUS STAR MAP

The position of the separator should be noticed, as no other position seems allowable The center of the separating ball should be in the straight line joining the centers of the bearing balls which it separates. For if it be located above or below, the pressure of the bearing balls will force it out or in. In either case, a new source of friction will arise from the rotation under pressure of this ball against parts of the bearing.

To hold the separator in place, some suitable means is required The separating ball will of course rotate against the holder But what is important is the fact that this rotation occurs without pressure. This is secured by the position of its center on the line of centers of the bearing balls.

There are a number of methods of retaining separator balls in position. Thus, in the double ball bearing, Fig. 10, there is a small tube in which the separator lies. This tube is funnel-shaped at each end. These funnels serve to compel the centering of the tube with the bearing balls. That is, when the bearing balls press against the two funnels, the axis of the tube is made to coincide with their line of centers, and this brings the center of the loosely held separator ball into its proper position.

In Fig. 10 is shown a radial bearing of the Chapman type. The tube with a funnel at each end may be clearly seen. Within the tube lies the separator ball, whose office it is to harmonize the contrary motions of the adjacent bearing balls. Of course, the ad- [illegible] ment that the [illegible] bearing balls [illegible] crowd [illegible] upon the separator ball, the contact with [illegible] is either slight or nothing at all. It is [illegible] however, that the funnel and the bearing ball [illegible] touch or approach each other fairly closely, as otherwise the centering of the tube with the line of centers of the bearing balls could not be counted upon to take place.

Ostrich Farming in Australia.

The first attempt to raise ostriches in Australia was made by a Mr Malcom, who in 1880 brought 100 young birds from South Africa to South Australia. In the following year the parliament of South Australia enacted a law which granted to the first person who should exhibit 250 ostriches, more than one year old, about 2 400 acres of land suitable for ostrich farming. The conditions were satisfied by the South Australian Ostrich Company, which was founded in [illegible], with a capital of $75 000. The company received land near Port Augusta on Spencer Bay, but in spite of this assistance the company has never paid a dividend, although it now possesses 1,190 ostriches, all of which were imported from South Africa. There is a still larger ostrich farm on the shore of Lake Albert, and smaller farms are scattered through the colony

In New South Wales, ostrich farming was first attempted in 1897, by Barracluff, who imported six pairs of ostriches from northern Africa, and now possesses 84 birds.

Queensland and Victoria possess only small ostrich farms, which have not produced very encouraging results. In all, there are now about 2,000 ostriches in Australia. The inferior feathers are used at home, and the more valuable ones are exported chiefly to Germany.

A CURIOUS STAR MAP

It would be more respectful to call this invention an "astronomical umbrella," but so many terms of humorous turn have been applied to the umbrella since the days of Jonas Hanway that it would be difficult for anybody except a boy scout to take this invention quite seriously

The inventor, Mr McEwan, is a Scotchman, and he has designed this apparatus for the study of the stars. The constellations and the Milky Way are all in their places, "ship-shape and Bristol fashion."

Just why an umbrella should have been used for this astronomical purpose surpasses our comprehension. In broad daylight such a chart would be obviously useless, and at night time nearly useless because of the difficulty of seeing the map at all

Utility of Beekeeping.

Beekeeping is a valuable aid in the cultivation of fruit and seed crops. Insects which feed on nectar play an important part in the fertilization of flowers. Fertilization is effected in other ways, but the agency of insects is the more certain and efficacious, and no other insect is comparable with the honey bee in this respect A strong hive contains 10,000 bees in February, 15,000 in March, 40,000 in April, and from 60,000 to 80 000 in May It has been discovered by skillful observers that the average load of nectar carried to the hive by a bee is about 3/10 of a grain, so that the collection of one pound of nectar requires nearly 23,000 foraging excursions. By means of hives set on balances it has been found that the daily increase of weight in May averages 3.3 pounds. Occasionally, more than 11 pounds is gained in one day, and when the amount consumed by the bees and the loss of weight by evaporation are considered, it appears probable that the average daily quantity of nectar collected is not less than 11 pounds, which would load 250,000 bees. As a bee visits 10 flowers on the average in collecting a single load, some 2,500,000 flowers are visited in one day by the bees of a single hive. An additional large number of visits is required for the collection of pollen These figures explain why many trees and plants bear small crops in the absence of bees.

The bee is charged with various imaginary crimes. Its sting is formidable, but chiefly to the imprudent. It is accused of ravaging fruit, but its tongue is formed exclusively for the extraction of sweet juices, and its mandibles are unable to pierce the skin of a fruit. Grapes have been taken intact from the interior of a hive in which they had been allowed to remain [illegible] days. A grape which had been smeared with honey was licked clean, but was not injured. The bees inserted their tongues in pinholes made in the skin of a grape, and extracted some of the juice, but they were unable to enlarge the holes. In [illegible] bees are menaced by insecticides intended for [illegible] insects. At [illegible], Italy, in [illegible] all the bees [illegible] killed by spraying the olive trees with [illegible]

THE SELDEN DECISION.

To the Editor of the SCIENTIFIC AMERICAN:

Your editorial in the SCIENTIFIC AMERICAN of September 25th on "The Selden Patent Case" interested me, as it seemed to me that the claim could be met without much trouble. Upon a cursory examination of my class of fire extinguishers, portable, wheeled, I find a patent to Bean, No. 75,848, March 10th, 1868, which shows every essential element of the claim in question, the single distinction in terms coming from the use of a steam engine instead of a gas engine. It would surely seem that this patent could not have been before the court as the decision would have been otherwise.

A. S DENNISON

U S Patent Office, Washington, D. C.

THE NUMBER OF OUR ANCESTORS.

To the Editor of the SCIENTIFIC AMERICAN

In the discussion of the "Number of Our Ancestors" in these columns your correspondents have been misled by the use of the word "ancestor" where kinship is defined. Under the great theory of the origin of life in a single cell or *protoplasm*, all living creatures are kin, and the number to which each individual is related is the total number which have been born into the world at the moment of the computation. The number for the preceding moment was something less, and if we go back the length of time embraced in a generation of mankind, the number in the kinship of the human family is many thousands less The further back we go toward the genesis of things the smaller the human family, and the number of one's ancestors certainly could not have been in an inverse ratio, as some of your correspondents have stated

The term "ancestor," however, cannot and does not mean the same as "kinship", nor, in its true sense, does it apply to more than the father and mother in each family The line of descent is a single thread running back through all ages to the very beginning of life, and in the social system of the present day the line is accorded to the male, but it could be as true of the female, it cannot be accorded to both, however, else the tangle which would ensue would strain and break the thread. These threads of anthropological progression are best conceived as the branches of a tree, living beings of the present being somewhat as the innumerable leaves, and the main trunk somewhere in the dim beginning, but in its formation each thread is like a flowing river where, tracing backward, we find branch uniting with branch, and each branch made up of uniting branch and branch, smaller and smaller, until even the rain drop is reached

So, with the infinite insight of the Creator we might start with any human being that ever lived, in any age, in any place, of any race or color, and by that single thread trace it back, back, back to the beginning previous to the first branching. And as we so trace each life thread we may count at each branch an ancestor for the direct descent and add one, the branch of the opposite sex there uniting—two in each generation—and no more, all else are but kin. Therefore the number of our ancestors resolves itself into the simple problem of the number of branches (generations) through which the individual has come multiplied by two.

CHARLES FRANCIS ADAMS.

Hampton, N H

Protection of Sown Crops from Crows.

Graminivorous birds exhibit, as experiments have proved, a marked aversion to foods of peculiar form and color, and also to certain aromatic and bitter substances. It has been found possible to give to seeds, without affecting their germinating qualities, flavors, odors, and colors which protect them from the attacks of crows, by the employment of cheap substances and simple methods of treatment. Suitable colors were found in Prussian blue, signal red, and anilin green. The pigments were strewn over the seed, which had been moistened with gum water. The seeds were then thoroughly mixed by shoveling and acquired a deep color. For the purpose of giving seeds a peculiar taste, pulverized alum and sodium sulphate, tobacco extract, and "Fichtenin," an insecticide used for foliage, were tried, but none of these substances materially altered the flavor of the seeds. Good and lasting results were obtained only with pulverized aloes, which also changes the color of the seeds over which it is strewn. A repulsive and persistent odor was given to the seed, without affecting its ability to germinate, by a weak solution of creolin.

In one series of experiments crows were fed with [illegible] quantities of pure seed and of seed contaminated with the [illegible], and the amount of seed left [illegible] in each case [illegible]. In another series, [illegible] of [illegible] seeds were sown in [illegible] [illegible] [illegible] applied to practice, the investigation proved that crows are influenced by color, taste and smell in their choice of food. Blue proved to be particularly repugnant, but green seeds were eaten very reluctantly, while red exerted a much slighter protective influence The treatment with aloes was especially effective. Although it produced very little change in the appearance of the seed, the rows sown with seeds so treated were destroyed *only in spots*. The seeds treated with creolin were also avoided, but "Fichtenin" proved wholly ineffective.

In continuing the experiments it will be especially advisable to try the effect of mordant dyeing on a large scale. Blue dyes appear the most promising, but the best results will probably be obtained with appropriate combinations of colors, flavors, and odorous substances.

Relation of Size to Speed in Ships.

BY SIDNEY G KOON, M M E

Mere size as an asset has considerable value, especially when it comes to a question of naval vessels. That this is so was strikingly illustrated a few years ago in a large shipyard, when it came to a question of the design of a fast cruiser to fulfill certain specified requirements. As a matter of fact, the cruiser was never built, but the calculations were made based on a set of lines which gave good model results, and the comparisons herein instituted are the fruit of considerable careful thought along the lines of the conflicting elements entering into the design of the modern warship

The original design embodies requirements that the vessel should carry a battery of two 8-inch and ten 5-inch guns, with four 3-inch automatic guns and two torpedo tubes, at a maximum speed of 23 knots. The coal carried on "normal" displacement was to be sufficient to carry the ship at 23 knots for a distance of 1,500 nautical miles. The hull was to be sufficiently strong to withstand at this speed the buffeting of a heavy sea.

The model test indicated an attainable admiralty coefficient of 240, based on shaft horse-power The steaming radius was calculated on an assumed consumption of 1 6 pounds of coal per shaft horse-power per hour The (turbine) machinery was designed and found to promise one shaft horse-power on 140 pounds everything included As worked out on this basis, the vessel was to have a length of 420 feet (waterline), a beam of 49 feet and a draft of 19 feet, the displacement, with block coefficient of 0 408, being 4,560 tons.

The horse-power required was computed by the usual admiralty formula

$$H = \frac{D^{2/3} V^3}{K}$$

where H is the horse-power D is the displacement, 4,560 tons ($D^{2/3} = 275$), V is the speed, 23 knots ($V^3 = 12{,}167$), and K is the admiralty coefficient, 240 H thus becomes 14,000, and the weight of machinery 1,960,000 pounds, or 875 tons. The fuel required at full speed is 22,400 pounds (10 tons) per hour, or 649 tons for a run of 1,500 nautical miles at 23 knots.

Of the other weight, 40 per cent of the displacement was allotted to hull and fittings complete (1,824 tons), 10 per cent to full equipment and stores including the officers and crew and effects (456 tons) another 10 per cent to a protective deck, the maximum thickness of which was 2¾ inches, while the remaining 300 tons took care of the battery, ammunition, and ordnance spares. The battery was practically without protection

While this design was under completion the question of a higher speed was mooted all other requirements as outlined above being fulfilled A design was thus prepared, the main dimensions of which were Length, 454 feet, beam, 53 feet, draft 20 feet 16 inches and *displacement, 5,750 tons.* The horse-power for 23 knots was found to be 16,300, which calls for 760 tons of coal to cover the stipulated radius of 1 500 miles

The weights of hull and of equipment and stores bear, naturally, the same ratio to the displacement as with the parent ship They are thus 2,300 tons and 575 tons, respectively The protective deck having the same thickness and general distribution as in the first case, weight 533 tons. The battery weights are constant at 300 tons. The sum of these five items gives a weight of 4,467 tons, which leaves 1,283 tons for machinery On the basis of 140 pounds per horse-power, this allows for 20 500 horse-power

Using the admiralty formula once more,

$$V^3 = \frac{HK}{D^{2/3}},$$

where H is 20,500, K is again 240 and $D^{2/3}$ is now 321 V^3 becomes 15,327, V is 24 84, or a speed of 24 84 knots may be expected to be realized It is thus seen that an increase in displacement of some 25 per cent here permits an increase of nearly 2 knots in speed

With the idea of determining to what extent further alterations in dimensions (while still preserving the [illegible] [illegible] proportions and general set of requirements) would affect the result, four other cases were briefly studied, two of vessels smaller than the first, and one much larger than the second The general characteristics of these four (C, D, E, and F), as well as of A and B, are shown in the accompanying table, the calculations having been made in each case as outlined above It will be seen that an increase in size to 8,900 tons (not quite double the original) brings the speed up to 27 9 *knots*, with 38 800 *horse-power*

Weights.	A	B	C	D	E	F
Hull and fittings	1 824	2 300	1 152	1 496	2,728	3,560
Equipment and stores	456	575	288	374	682	890
Protective deck	456	532	333	400	597	711
Battery and ammunition	300	300	300	300	300	300
Machinery and water	875	1 283	227	602	1,083	2 426
Fuel	649	760	478	568	850	1,018
Total displacement	4 560	5 750	2,880	3 740	6,820	8,900
Total horse power	14,000	20 500	3 630	9 650	26,000	38,800
Horse-power for 23 knots	14 000	16 300	10 250	12 200	18 250	21 750
$D^{2/3}$	275	321	202	241	360	429
V^3	12 167	15 327	4,318	9 610	17 733	21 706
V, or speed in knots	23 00	24 84	16 28	21 26	26 08	27 9
Length of water line feet	420	454	360	390	480	504
Beam, feet	49	53	42	46½	56	61½
Draft of water, feet	19	20½	16¾	17¾	21⅝	23⅝

It will be noted that, after satisfying all other requirements, the design marked C has left only 227 tons to devote to machinery thus allowing for but 3,630 horse-power This would make possible a speed of only 16 28 knots Hence, the provision of covering 1,500 nautical miles at a speed of 23 knots is a manifest impossibility To reach this speed, 10 250 horse-power is required calling for 641 tons of machinery If this speed is required of this ship and all other demands be met except steaming radius we find that we have left only 64 tons for coal which would correspond with a radius of but 201 nautical miles. Similarly with D, 23 knots calls for 12 200 horse-power and 763 tons of machinery This reduces the coal supply to 407 tons, and the steaming radius at 23 knots to 1,075 miles.

This study of course neglects all variations in results which might accrue from variations in the conditions imposed Thus, by reducing factors of safety, lower hull weights could be obtained and this is frequently done especially on the smaller ships *In the* same way more power might be obtained from a given weight allotted to machinery In this manner the smaller vessel might be made to accomplish the results here attained only by the larger But such methods are obviously inadmissible where strictly comparative results are desired and especially so where the effect of a mere change of size is to be determined

The Current Supplement.

In a paper entitled The Origin of Life,' read by Prof E H Starling before the British Association for the Advancement of Science, and published in the current SUPPLEMENT, No 1766 the broad ground is taken *that a living organism may* be regarded as a highly unstable chemical system which tends to increase itself continuously under the average conditions to which it is subject, but undergoes disintegration as a result of any variations from this average The practical applications of the microscope are pointed out by J E. Barnard Some new safety devices for steam boilers are described Of aeronautic interest is an article on experiments with models of airships and aeroplanes in the laboratory and a continuation of last week's discussion of the Paris aviation meeting The Loetschberg tunnel through the Bernese Alps is described by Dr Alfred Gradenwitz E E Carey contributes an excellent article on the electro-chemical age, in which he points out that the science of metallurgy is now entering a new era. The opening of the mounds of the great capital of Egypt is the largest enterprise yet started in that country It will probably take twenty years to complete The preliminary work of 1907-8 at Athribis is described in an article by Prof W Flinders-Petrie entitled Memphis and Its Foreigners." Recent progress in chemistry is reviewed by Prof H E Armstrong

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A *committee of investigation* has been appointed by the American Railway Association to report upon the railways which have adopted electrification This committee is composed of officers of roads which have electrified portions of their lines or contemplate doing so The railways represented on the committee are the Illinois Central Union Pacific Southern Pacific Erie, Delaware and Hudson, and New York New Haven & Hartford A proposal is now before the New York Central lines to lay out considerably over $20 000,000 during the current year, largely for the continuation of the electrification work at the New York terminal Another section of the West Shore road between Syracuse and Utica will be electrified and some double tracking elimination of level crossings and gradient revision will be carried out around Rochester and Buffalo A considerable amount of new equipment will be purchased.

THE 10,000-TON SUCTION DREDGER "LEVIATHAN" FOR USE ON THE MERSEY

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN

Owing to the increasing draft and tonnage of steamers frequenting the port of Liverpool, the maintenance of an open channel in the estuary is one of vital urgency Dredging upon a vast scale has to be maintained continuously to remove the sand, which threatens to silt up the navigable channel, and in order to carry out this work most efficiently the Mersey Docks and Harbor Board found it necessary to undertake the construction of a special type of dredger The task of evolving such a craft was intrusted to their engineer-in-chief Mr Anthony G Lyster M I C E who is familiar with the peculiar conditions prevailing at this port and who designed the sand pump dredger "Coronation which built in 1903 was at that time the largest and most powerful dredger of its type afloat This latter vessel 332 feet long by 53 feet beam and 20 4 feet deep, with a gross tonnage of 3 943 tons and capable of dredging to a depth of 65 feet with a pump capacity of 4 500 tons per hour proved eminently successful and he decided to design a new craft upon the same broad lines

The new vessel, the 'Leviathan' has now been placed in service and ranks as the largest and most powerful dredger that has yet been placed in operation in any part of the world It has an over all length of 487 feet a beam of 69 feet and a depth of 30 feet 7 inches these large dimensions being necessary to afford the requisite capacity and strength to carry the designed enormous load of 10 000 tons of sand It is of the twin screw self propelling sand pump hopper-dredger type, provided with twelve hoppers having a net total capacity of 180 000 cubic feet and is fitted with pumps capable of dredging and filling itself with this load of clean Mersey sand in 50 minutes from a maximum depth of 70 feet while the propelling machinery is sufficient to enable her to drive this load of 10 000 tons in her normal steaming trim with coal bunkers and water tanks full at the rate of 10 knots under ordinary working conditions and to discharge this load very rapidly The gross tonnage is about 8 000 tons and the full load is carried on a mean draft of 23 feet The fulfillment of these conditions insures the boat s possessing three times the power and capacity of any of the Harbor Board s existing dredgers including the Coronation which is the next largest craft of this description in operation at Liverpool

The vessel constructed by Messrs Cammel Laird & Co the well known British armament manufacturers and naval shipbuilders at their Birkenhead works is built of steel to class 100 A 1 at Lloyds. It has a complete steel upper deck sheathed with wood and is divided transversely by thirteen watertight bulkheads extending from keel to deck There is a longitudinal center line bulkhead dividing the hoppers pump rooms, and boiler rooms as well as No 2 buoyancy spaces on either side of the vessel These subdivisions taken in conjunction with the watertight hopper side bulkheads divide the vessel into about thirty separate watertight compartments The steel structure has been arranged to give special strength to the vessel in view of the great strains developed in loading and unloading the hoppers

The dredging plant of the Gwynne type, comprises four sets of inverted vertical triple-expansion, surface condensing, direct-acting engines having a total indicated horse-power of 2,800, coupled direct to four independent sets of centrifugal suction pumps connected to their respective suction tubes, two on each side of the vessel, with hydraulic sluice valves on the inboard side Each tube has an internal diameter of 42 inches is 90 feet long, and is bolted to a heavy cast-steel swivel bend at the upper end and a strong nozzle of special design at the lower extremity These nozzles are provided with a cast-steel grid, so as to exclude material of such a size as would foul the pump The swivel bends work in vertical slide frames riveted to the vessel's side, with trunnions to permit the suction pipes to hinge about its center and thus permit raising or lowering to conform with the state of the tide during dredging

The suction pipes have an inclination of 45 degrees when dredging to their lowest limit of 70 feet below sea level Each tube is lifted and lowered by two strongly built derricks of steel, one at each end of the tube and stopped on seats at the upper deck complete with blocks and flexible steel wire ropes led on to drums of its respective hoisting winch

Fitted over each side frame are deck slides supported by strongly built seats on deck, to enable the suction pipes with swivel bend to be stowed inboard when not dredging Each deck slide has a heavy cast iron frame of the same section as the slide frame and can be moved inboard or outboard by means of worm gear the same being carefully adjusted so that it comes exactly in the same vertical plane as the slide frame when at its extreme outboard position to permit the suction pipe to be lowered to its working position below the water level

Emergency gear is fitted to each suction tube so that in the event of an accident the suction tubes may be lifted by block and tackle led to the deck winches Two of these winches are placed under the forecastle deck and two on the poop deck The four hoisting winches are inclosed in steel houses fitted with glass fronts so that the winchman within has a clear and uninterrupted view of the derrick lifting and lowering gear Each hoisting winch has four drums arranged in pairs two for raising and lowering the suction pipes and the other two for derricking in or outboard These powerful winches are actuated by double-cylinder reversing steam engines.

The four dredging pumps are arranged to deliver the excavated material along pipes passing up through the deck into two landers and at the point where they joint hydraulic sluice valves are fitted The landers are placed side by side with a center division and run the full length of the hoppers The lander valves worked by worm gear are placed over each hopper on the bottom of the landers, so that the discharge to any hopper can be controlled as desired By these means the valves with control gear are also arranged in the steel division separating the two landers The discharge of sand and water from any or all, of the pumps can be controlled so as to trim the vessel as necessary

The hoppers placed forward of the pumping-engine room are built in twelve separate compartments, six on each side of the center line bulkhead Each is fitted with Lyster's patent valves having an opening 5 feet 6 inches in diameter through the bottom of the vessel The hopper bottom plating has a steel slope in the four directions down to the edges of the valve seat bottom casting for quick discharge of the sand.

(Continued on page 339)

THE 10,000 TON DREDGER "LEVIATHAN,' WITH A 500-TON SAND PUMP DREDGER ALONGSIDE.

SOME CURIOSITIES OF INVENTION.

From time to time we have collected in these columns instances of perverse mechanical ingenuity as well as misdirected efforts on the part of inventors, partly for the purpose of amusing the more soberminded, and partly as an instructive object lesson. On the opposite page will be found a number of such mechanical curiosities, some of them without any excuse whatever for their existence, others not without merit. We are indebted to the Illustrated London News for these examples.

The man who invented the padded chair and traveling carrier to prevent serious street-car accidents was evidently as much concerned with the comfort of the person to be saved after collision, as with the mere act of saving He has provided a fender which consists of a traveling belt and which serves the kindly purpose of conveying its human freight to a comfortable chair It would seem from the illustration that the man to be saved is expected to be picked up in a sitting position facing forward so that he may be conveniently lodged in the padded seat. If he were picked up prostrate, he is presumably either dead or unable to sit, for not otherwise can we account for the chair

The umbrella cap which emanates from the mind of another inventor certainly ought to serve its purpose of shielding the wearer from rain and sun if one may judge from the illustration It is assuredly no uglier than the headgear in which civilized man now disports himself

The method illustrated for arresting a runaway horse is certainly one of the wildest fancies which we have ever seen The plan is nothing more or less than simply to lift the runaway horse bodily by using a derrick Presumably the driver is to manipulate the derrick boom Surely only a Titan could succeed in raising even the half-starved animal that is harnessed to the average tradesman s wagon.

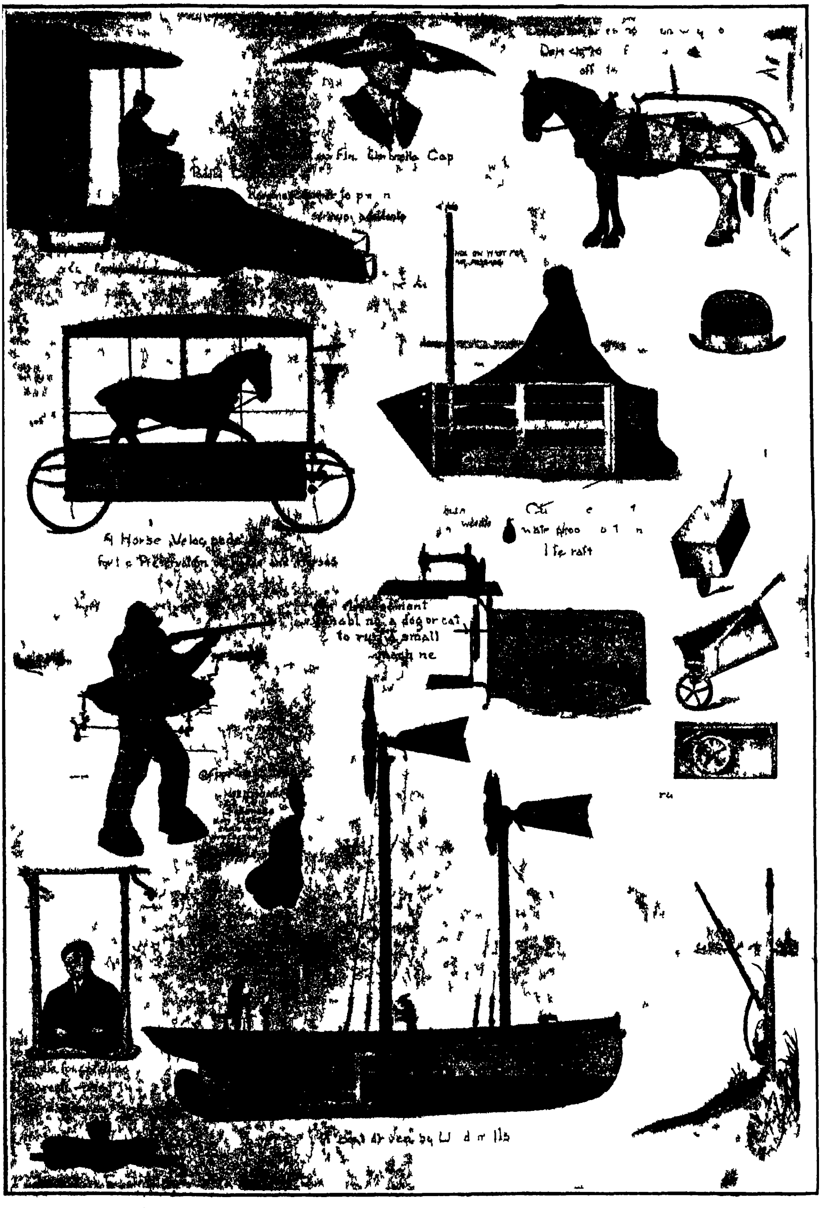
The inventor of the horse velocipede pictured was concerned chiefly with the preservation of roads and horses' shoes He places his horse upon a kind of treadmill which is operatively connected by crank mechanism with the road wheels. Presumably this wheeled horse is to be used as a kind of locomotive to draw the car

The many disasters at sea have no doubt, inspired the inventor of the combined waterproof coat and life raft which is illustrated A central hollow structure is connected with a waterproof coat into which the passenger crawls and thus makes himself literally part of the life raft Inasmuch as a hollow mast is provided to supply air to the interior of the life raft and water and inasmuch as provisions are there stored, the man in the rubber coat must have access to the interior A counter weight is provided to enable him to keep the raft in proper trim

The inventor of the cigar holder for hats which is also to be numbered among these curiosities, seems to have been dismayed by the waste space in an ordinary "bowler" hat, for he has devised a means of utilizing the unoccupied space in a way which leaves one to infer that he never heard of pocket cigar cases.

We believe that something like the sporting dress here shown has actually been used, but certainly not equipped with the hand-operated screw propellers. As shown in the detailed view, separate airtight chambers *a a* are employed, which are protected

(Continued on page 340.)



Pictures from Illustrated London News

SOME CURIOSITIES OF INVENTION

THE ATTITUDE OF DIPLODOCUS.

Readers of the SCIENTIFIC AMERICAN are familiar with the prehistoric animal known as "Diplodocus," the largest of dinosaurs. To the American Museum of Natural History, and particularly to Prof Henry Fairfield Osborn, president of the Museum, is due much credit not only for the arduous work of excavating the bones of this and other extinct creatures in the far West but also for painstaking care in correctly mounting the skeletons.

The donation of a Diplodocus skeleton through the kindness of Mr Carnegie to the Berliner Museum fuer Naturkunde has brought this extinct animal much into the public eye in Europe Dr Tornier is largely responsible for this increased popular interest in palæontology because of the paper which he recently read before the Gesellschaft naturforschender Freunde on the structure of the Diplodocus skeleton in the Berliner Museum a paper based largely upon the studies of Hay and therefore hardly the result of original investigation The Berlin diplodocus is mounted in the attitude of a mammal, with extended legs Tornier holds that its posture should have been more reptilian We abstract from Umschau an account of Tornier's views Dr Tornier argues that four-footed lizard like reptiles rise but little from the ground even when in active motion that the humerus and the femur move in approximately horizontal planes, so that the animal crawls rather than walks. The Diplodocus was a reptile a giant lizard in other words. Tornier holds that the skeleton has been incorrectly mounted and that its posture should have been that indicated in Fig 1 rather than that indicated in Fig 2 If the animal had been mounted as in Fig 1, it would have walked somewhat like a crocodile, which, in Dr Tornier's opinion it did

In the reconstruction of Diplodocus the hind feet rest flatly upon the ground, whereas the fore feet touch the ground with the toes only Hatcher who was one of the first to study the animal closely thought that perhaps the fore feet were placed flatly upon the ground Holland disputed this view Dr Tornier believes that Holland was right, because reptiles do not tip-toe with their fore feet and because, so far as we know, there is no land animal which employs only the toes of its front feet and the soles of its hind feet in locomotion

Dr Tornier holds that the tail of Diplodocus was a far more important member than the mounters of the skeleton suspected In the Berlin model only the end of the tail rests upon the ground the remaining portion rising at a fairly sharp angle to join the lumbar vertebræ He stated that in order to mount the tail in this manner and to produce the pronounced curve of the reconstruction it was necessary to spread the vertebræ of the tail He states that the caudal vertebræ of lizards are never separated in this fashion, but that they are more or less locked together Inasmuch as the Diplodocus vertebræ are reptilian in form he believes that here again an error was made and that the tail did not curve up sharply from the ground but that it projected rearwardly in a slightly curved line as in all reptiles In the restoration only one-half of the tail rests upon the ground, the other half rising free into the air If this were correct the rear extremities of the animal would have been compelled to support an enormous load of bone which served no useful purpose. In typical four-footed lizards it is the function of the tail to guide the animal. As soon as the animal begins to move, the tail stiffens the spinal column, thereby enabling the animal to proceed rapidly along in a straight line. If the tails of such animals be cut away, they seem to be no longer able to move properly It was the purpose of the tail of the Diplodocus to stiffen the lumbar vertebræ, as in the case of all lizards, when the animal was in motion. Moreover, it served to counterbalance the head of the creature and to prevent it from tipping over forward, particularly when it was traveling down an incline.

Dr Tornier is of the opinion that Diplodocus did not hold its head horizontally but that the neck was habitually curved in the form of an S Holland also made this assumption and likened the head and neck of Diplodocus to the head and neck of an ostrich The evidence for this attitude of the head is to be found in the peculiar ball-and-socket connection of the neck vertebræ It was the object of this form of articulation to enable the neck to be extended to all sides as well as up and down

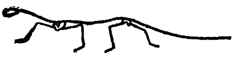


Fig 1.—Tornier's conception of the true position of Diplodocus.

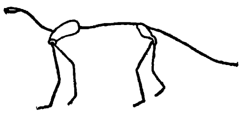


Fig 2.—Present mounting of Diplodocus.

It must not be assumed that Dr Tornier's criticism of the mounting of Diplodocus meets with general European approval Dr Fritz Drevermann, curator of Senckenbergisches Museum Frankfort-on-the-Main, believes that there is room for two opinions. He points out that Dr Tornier's conception of the position of the legs of Diplodocus is based on Hay's view If American students and particularly Prof Osborn (under whose direction the Frankfort Diplodocus was mounted) Hatcher Holland, and the Viennese Abel regard the present position as correct, it is not likely that Tornier is right. It is inconceivable that the palæontologists of the American Museum of Natural History who have mounted Dinosaurs by the dozen, are ignorant of reptilian skeletons

Marcellin Boule professor of palæontology at the Museum d Histoire Naturelle, Paris, agrees with Drevermann He too argues that American authorities are fairly in accord on Dinosaur reconstruction and that the few disagreements affect only minor details. Inasmuch as Americans alone have had an opportunity of finding Dinosaurs in any number, and therefore have had the best opportunity of studying them, their opinion must be accepted as authoritative. He quotes B. P Hay, who does not agree with most American students and who seems to have inspired Tornier. Prof. Boule contends that Tornier is wrong in thinking that mammals have one form of locomotion and reptiles another The conclusion that because Diplodocus is a reptile it must crawl is not necessarily valid. Locomotion is dependent upon external conditions. As a matter of fact there was once a time in the history of the earth when reptiles were lords of widely different elements. They dominated the water as Ichthyosaurs, Plesiosaurs and Mosasaurs, they roamed the earth as Dinosaurs and navigated the air as Pterosaurs. If present reptiles are limited to a crawling movement that is by no means conclusive proof that they always crawled.

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Chartreuse Liqueur Decision.

Consul C P H Nason, of Grenoble, submits the following report on the French legal decision concerning the name "Chartreuse" as applied to liqueurs

The court of appeals at Grenoble on June 22nd rendered a decision in the long-discussed case turning upon the rights involved in the public sale and use in France of the trade-mark "Chartreuse." After the expulsion in 1903 of the Carthusian monks from their convent, La Grande Chartreuse, the making of the well-known liqueur (the distilling of which and the aromatic plants entering into its composition were claimed to be known) was intrusted on the part of the state receiver to a prominent French distiller The latter, as against the sale by auction of the very valuable trade-mark under which the liqueur was universally known, made a written advance offer, on the basis of which the bids were to begin at 1 500,000 francs ($289,500) Thereafter came forward a second party and guaranteed the receiver an auction offer of 5 000,000 francs ($965,000), but this was finally reduced to 3,000,000 francs ($579,000)

This agreement the second party failed to keep, he withdrew the offer, and as a consequence, at a forced sale to the highest bidder the right to the trade-mark was sold to a company formed by the first party for the sacrifice sum of 502,000 francs ($96,886) Whereupon the receiver brought suit against the second party for breach of contract, and the latter, after a strongly contested trial was condemned by the civil court of Grenoble to pay the former for non-execution of contract 1,094 000 francs ($211,142) An appeal was taken from this judgment, and after another prolonged hearing and arguments by eminent advocates, the court has not only affirmed the fault and responsibility of the second party, but increased the damage interests to be paid the receiver to 2,438,000 francs ($470,534)

The use in this country of the trade-mark Chartreuse was decided by the two lower United States courts against the Chartreux monks and in favor of the new French company An appeal is, however, pending

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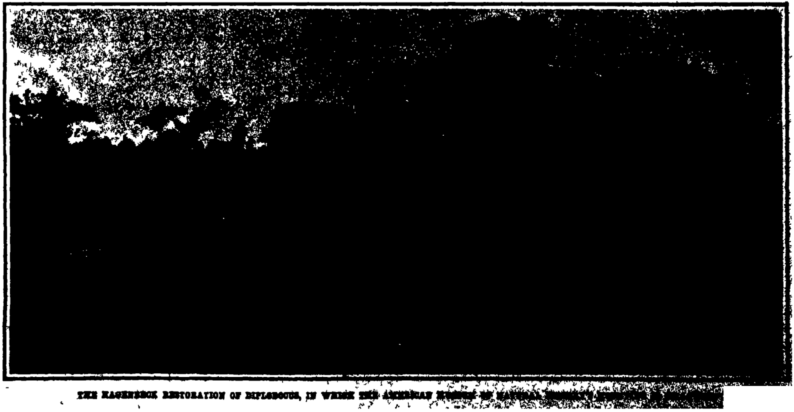
According to the latest statistics, the total peat bogs of Sweden would be capable of producing 10,000 millions of tons of air-dried peat, suitable for fuel. This quantity, as compared with the present import of coal, would be sufficient for a period of 1,500 years. More exact examinations of the geological character of the peat bogs will soon be started by the Swedish Geological Society



THE HAGENBECK RESTORATION OF DIPLODOCUS, IN WHICH THE AMERICAN MUSEUM OF NATURAL [illegible]

BIRDS OF PASSAGE.

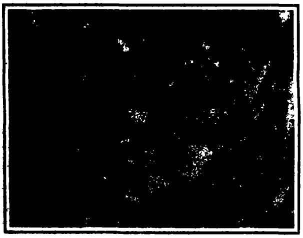
By A. S. Powers.

It is a far cry from the day when Aristotle propounded the doctrine that birds hibernate like wood chucks, to the present time, yet much of the mystery which that early naturalist sought to dispel still lingers about the wonderful phenomena of migratory movement.

Only in birds (unless we except fishes) is true migration instinct found. Erratic, semi migratory movements of insects take place; scarcity of food or some other strongly compelling cause induces, from time to time, a semblance of migration among some of the mammals, but only the winged and feathered inhabitants of the globe exhibit a seasonal rhythmic swing from south to north and *vice versa*.

Our modern knowledge embraces much data respecting the actual migratory movement, its date of commencement, duration, and termination, the termini of the journey, the route followed, and the manner in which the traveling is performed. We have accumulated a great mass of statistics concerning the time in spring and fall when certain feathered wanderers may be reasonably expected to appear at a given point along their route. We know that the method of performing these journeys varies much between species, as in length of flight that takes them from winter to summer homes and return, whether they fly almost continuously or by short, leisurely stages, whether flights are mostly by day or night or both, the route followed, and whether this is changed by varying weather or other conditions. We also know that certain species perform their flight to their northern summer homes along one route, and return to their southern winter homes by a widely different course It is well established that some species flock and fly almost entirely by themselves, that others are found widely scattered among flocks of other species, that in still other cases two or three species may almost certainly be found flocked together, while in some instances the flight is performed more in an individual and straggling manner It is a fact well known to many gunners that the course and manner of certain species of migrating birds has been changed materially within recent years, perhaps permanently, and that temporary changes of this character constantly occur, due to easily recognized causes. That class of birds whose life cycle is, perhaps, best known is naturally the one which includes those classed as game birds Notably, as regards migration, these birds fall readily into three divisions: the water fowl, including ducks, geese, and swans, the Limicolæ or shore birds, principally the sandpipers and plovers; the gallinaceous birds such as the bob-white or quail and the ruffed grouse or partridge.

The downy woodpecker at home, a non-migratory bird


The nest of the Florida gallinule built for years in the same site, even after the marsh has become the center of a hustling city section

The southward fall migration of the first-mentioned division may, perhaps, be readily ascribed to search for wide and rich feeding areas, where open water [illegible], the northern flight to a similar seeking of ample breeding grounds. While the southward flight is in some few instances continued as far as the West Indies and South America, in the main the movement is only sufficient, and in general seems to conform to the same [illegible], in suitable localities [illegible] the New England coast and [illegible] Long Island we find [illegible] representatives of their [illegible] during the [illegible] of winter; while in the wonderful breeding grounds along the coast of North Carolina, their numbers seem only to be limited by the persecution of the gunners. The northward journey of the members of this division it is true, is for the most part extended well into the Arctic or sub-Arctic regions, but this is largely a matter of necessity, to secure sufficient areas of suitable nature where they may breed in peace Where birds of this division are not harrassed in late winter and spring by shooting it has been found that they often remain in considerable numbers to breed, much further south than the usually ascribed southern limit of summer residence

On the other hand the migratory movement of the second division mentioned is one of the most extreme known Such birds as the golden plover, black bellied plover, buff breasted sandpiper, and others of their kind are startling examples of the most wonderful migration flights. The golden plover breeding within the Arctic Circle often extends its quarters as far south as Patagonia. Of necessity the breeding season is short, but nearly six months is spent in winter homes. About four months of the year is spent in their spring and fall journeys, which are sometimes as much as 3 000 miles in length In spring they travel northward *via* the Mississippi Valley but in fall they go south by the way of Labrador and Nova Scotia from the latter point launching out to sea and in favorable weather often making a trip of 2 400 miles to South America without a known stop There seems good reason to believe that this avoiding of our coast has increased in frequency since the shooting of the birds by the barrelful so reduced their numbers and endangered a coastwise journey overmuch

The black bellied plover breeds equally far north and on this hemisphere winters in the West Indies Brazil and Colombia The buff breasted sandpiper summers as far north as the Arctic coast and winters south of Uruguay and Peru Migratory movement in all such birds has been undoubtedly affected by changed coastal conditions and excessive shooting

The third division represents birds that are practically unaffected by migratory instinct The bob-white and ruffed grouse are permanent residents where found, till adverse circumstances force them to leave or extermination removes them from a locality

The most fundamental factor in migration the cause remains practically unknown so far as birds in general are concerned The formerly attributed cause and the one which still figures largely in the popular mind, and seeking of a comparatively equitable climate by birds in their journeyings north and south, has long been abandoned by the ornithologist The question of food supply only offers partial solution This is true of other tentative causes advanced It seems probable that a number of causes in a great variety of combination contribute

The osprey's nest to which the birds return year after year

In the study of migration one fact seems to be unmistakably established namely the existence of an extinct that enables birds in flocks or individually to perform migratory flights of great length and to return with great precision to the breeding spot of the previous year Thus we find birds that breed gregariously as gulls terns herons and others yearly returning to the same island strip of beach marsh or swamp in a colony and about the same time each year In the same way our common birds that are more or less solitary in their nesting habits return in many instances to the same spot year after year The bridge girder the beam in the cow shed or the molding on the porch pillar that has this year held a phœbe's nest will ten to one hold such a nest next year It is not exceptional to note on the limb of a village shade tree the occupied nest of the Baltimore oriole the weathered last year's nest and the battered remains of the nest of two years ago A last year's nest of the vireo is often a good clue to the immediate whereabouts of an occupied nest Robins nests are not infrequently built on the remains of the domicile of the year before A hawk's nest is often used for many years in succession and this is particularly the case with the fish hawk or osprey whose nests thus added to year by year often become very bulky with the underpart or foundation a crumbling mass of age-decayed matter Woodpeckers who seldom use the same nest twice often have two or more excavations in the same stub the nesting cavities of successive years

All this evidence of a return of individual birds to a given locality is of course not absolutely conclusive It is seldom possible to adduce such conclusive evidence The reasonable conclusion however must be that the weight of evidence is in favor of the theory

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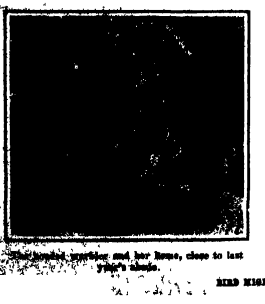
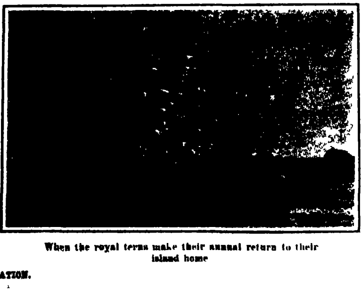

The hooded warbler and her home, close to last year's abode.


When the royal terns make their annual return to their island home

BIRD MIGRATION.

THE OPHTHALMO-DIAPHANOSCOPE.

The ophthalmo-diaphanoscope is an instrument for examining the fundus, or back of the human eye. It is the invention of Dr Carl Hertzell, of Berlin who claims that the instrument and its accessories supersede anything that has previously been in use. Briefly, the instrument consists of an eighty candle-power electric lamp which the patient holds in his mouth, as far back as possible This highly illuminates the retina of the eye from the back, and the surgeon looking at it from the front, is able to make a much more satisfactory examination than was possible by means of reflected light and eye-mirrors

Of course the examination takes place in a totally dark room while the patient wears a black mask over his face in order to concentrate the effect of the illumination holes being cut in front of the eyes, through which the surgeon makes his observations

These are the essential points connected with the ophthalmo-diaphanoscope and its working There are, however a few other details connected with the invention which are of particular interest. The illumination which is concentrated at one end of the tube is ten times more powerful than that which is emitted by any other lamp previously employed in surgery for transmitted light As we have seen, the normal candle-power is eighty, and a moment's reflection will convince the reader that it would be quite out of the question to make use of an ordinary lamp of this kind in the mouth or indeed in close contact with any part of the body because of the great heat which is generated This difficulty has been surmounted by means of a continuous stream of cold water which circulates within the lamp In the complete equipment, the water is stored in a glass reservoir supported upon a column, down the hollow of which the fluid passes to a flexible tube which carries the stream into the lamp through which it circulates A similar tube carries away the waste water which is ultimately discharged into a vessel at the base of the apparatus

A necessary and most ingenious addition to the ophthalmo-diaphanoscope is the contact signal lamp which is fixed to the column beneath the reservoir, that is to say about on a level with the eyes of the surgeon when he is making an examination of the patient

This lamp lights automatically just before all the water is discharged from the reservoir, so that no matter how much absorbed the surgeon may become in his examination he will be at once apprised that the reservoir is almost empty by a sudden illumination of the darkened chamber He can then at once switch off the current from the lamp, which now that the cooling stream has ceased to flow would become heated and cause discomfort to his patient

It should be added that the outer cover glass of the special lamp is readily removable, so that it may be sterilized after each use Moreover every part of the lamp may be had in duplicate and as these are perfectly interchangeable a broken or faulty part may be at once replaced The whole apparatus has been devised with the utmost care and it is claimed that even those who are unfamiliar with electrical appliances may quickly become accustomed to its use

The ophthalmo-diaphanoscope was specially invented as an aid to diagnosing diseases of the eye, but it has proved of great service in examinations of the throat and nasal cavities while it will probably prove of service to medical science in many other ways. Its chief advantage lies in the fact that an extremely powerful light may be obtained without heat radiation

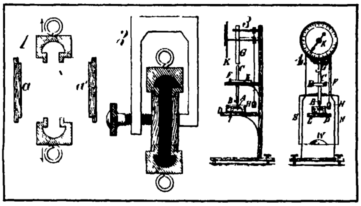
THE OPHTHALMO-DIAPHANOSCOPE.

◆

TESTING BITUMENS FOR PAVEMENTS

In every direction the industrial and scientific worlds are endeavoring to measure the properties of substances An instance of this tendency was given in the article on 'Testing for Hardness' in the SCIENTIFIC AMERICAN for August 29th 1908 In the present article it is proposed to give some account of measurement efforts in a very different field of activity

The sheet asphalt pavements so common in certain parts of the United States are composed of an admixture of some asphaltic cement and sand It is quite important to have pretty exact information about this bituminous cement in advance of its use in paving mixtures One reason for this is that the cements are by no means all alike. And second the requirements for this use and that vary greatly Thus it comes about that it is a matter of considerable importance to determine the characteristics of samples in course of manufacture or an advance of actual use In fact, since the asphaltic cement is the controlling factor in the mixture used in sheet asphalt paving it is very necessary to make this cement with just the properties suited to the particular case in hand. That is to say, asphaltic cement is a combination of refined asphalt and some tempering oil, as residuum petroleum. It will readily be seen, then, that the properties of the cement will vary with the relative quantities of the two ingredients, to say nothing of the characteristics of the particular asphalt and oil used. For practical purposes, then, it is found very desirable to know in advance whether the cement being made is going to be what is wanted.



Figs 1 and 2 show mold for sample prism Figs. 3 and 4 show side and front views of the Dow penetrometer.

There are two principal properties whose determination is sought. These are ductility and viscosity.

In order to measure the ductility, the following method, due to Mr A. W Dow, may be employed: A mold of four pieces is constructed, the plan view of these being shown in Fig 1 These pieces are set up on a brass plate which forms the bottom. The side parts are held in position by a clamp, as shown in Fig. 2 The interior portion of the mold is in the form of a prism, 1 x 1 x 5 centimeters The cement is now poured in, hot of course When cool enough, the top is smoothed off. When the temperature has fallen to the point at which it is desired to make the test, the clamp is loosened, and the two side pieces aa' (Fig 1) are removed We now have a prism of cement held at the sides by clips—the end pieces of the mold By inserting hooks in the eyes of the clips, it is easy to arrange matters so that these clips may be steadily drawn apart This may be accomplished by hand. Mr Dow mentions the rates of separation as 5 centimeters per minute for the temperature of 77 deg. F., and of 1 centimeter per minute for 20 deg. F. It is stated that 'it is not safe for an asphalt having a consistency of 40 penetration at 77 deg F to pull less than 20 centimeters at this temperature" What is meant by 'a consistency of 40 penetration" will become clear in the sequel

In order to measure the viscosity (consistency) of a cement, recourse is had to a device for measuring the depth of penetration accomplished by a weighted needle in a given time Prof H C Bowen is said to have invented the pioneer machine about twenty years ago Several devices have been developed since. The one which is probably most in use at the present time was devised by Mr Dow But this latter has now been improved upon by Messrs. Richardson and Forrest.

In the Dow machine, a broad upright rises at the rear of a base, as shown in vertical section in Fig 3. The specimen of asphaltic cement is contained in a small tin box *L* immersed in water in a suitable receptacle. This last rests upon the shelf *D* An aluminium rod *C* is held by a clamp *E*, controlled by a button *F* A No 2 cambric needle *A* is inserted in a brass rod, and this latter is held in position in the aluminium rod by the screw *B* Attached to the aluminum rod *C* is the framework *SS*, Fig 4, carrying a weight *W* It will readily be seen now that by looking the clamp *E* open, by means of the button *F*, the needle, weighted by the parts *C*, *SS*, and *W*, may be brought into contact with the upper surface of the specimen, and allowed to begin penetration

There are two remaining things for which mechanism must be arranged There must be some means of measuring the time and the amount of penetration. The former of these is quite a simple matter A pendulum beating half-seconds is arranged at some convenient point of attachment The second requirement is accomplished as follows In Figs. 3 and 4, *G* is a rack meshing with a pinion back of the dial *K*, and controlling the indicator At the rear end of the spindle carrying the pinion is a drum. A rather thick thread is wound about this drum, and weighted at its lower end by the weight *H* This last is of such amount as just to counterbalance the weight of the rack on the pinion. Consequently, if the lower end of the rack is brought into contact with the aluminium rod *C*, it will not contribute any influence to the penetration of the needle. At the beginning of the test, the lower part of the rack is brought into contact with *C*, and again at the conclusion. The difference in position of the rack will, therefore, give the amount which the [illegible]

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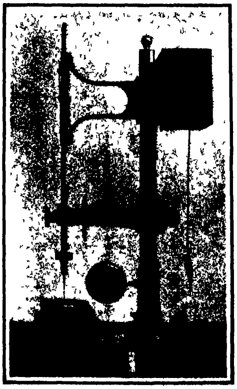

Side view of the improved penetrometer.

Pendulum and indicator dial.

TESTING BITUMENS FOR PAVEMENTS.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

SUPPORT FOR GARMENT-HANGERS.—FABIAN WOLF, New York, N. Y. This support is adapted to be secured beneath a shelf or within a wardrobe, showcase, or the like. The invention relates more particularly to a carrier in which a plurality of rods are used, one being longitudinally movable in respect to the overhead support, and another of the rods being carried by the first-mentioned one and also longitudinally movable in respect thereto, so that the support may be extended to its full length out from beneath the overhead support.

Electrical Devices.

TROLLEY-GUARD.—S. G. WILCOX, North Adams, Mass. The guard is in the form of a spring-pressed slidable plate, nominally extending across the top of the trolley wheel, to prevent it from leaving the trolley wire, the plate readily passing the trolley wire hanger, and the arrangement permitting withdrawing of the plate by the operator at the same time pulling down the trolley pole.

IGNITION APPARATUS.—G. HANIQUET, Longbeach, Cal. It is sought in this invention to provide means for retaining a thin lubricating oil within a circuit closer. In addition the invention comprehends mechanism for reducing the electrical arcking as the contact shoe leaves the contact bar. It further contemplates slowing down the speed of the circuit closer shaft, as compared with the main shaft.

INSULATOR.—P. S. DUMBOLTON and F. FRANK, Burke, Iowa. The invention is more particularly an improvement in insulators mounted on spiral wire coils which are suitably attached to a supporting screw pin. It is adapted for lateral oscillation so that it may be used without danger of breaking as is often the case with insulators so fixed on their supports as to be incapable of yielding to jar or vibration.

INDUCTOR DYNAMO.—G. A. COLMAN, Seattle, Wash. The more particular purpose of the inventor is to produce a dynamo having a minimum of wearing parts and without brushes, collectors, or commutators. It relates to the construction of a high-speed rotor having generally the form of a smooth disk made entirely of solid metal, yet heterogeneous as to the magnetic properties.

Of Interest to Farmers.

CULTIVATOR ATTACHMENT.—D. B. BROWNING, Morrison, Okla. In operation the fender is supported by the hanger arm and the runner is adjusted a sufficient distance below the edge of the blade to prevent the soil thrown up by the plows from covering the plants, while permitting some soil to be thrown toward the plants at the roots. Engagement of the runner with the ground prevents the fender being moved out of place by the soil thrown up by the plow. The runner also permits the fender to fall in with the inequalities of the ground, so as to protect the plants, even when they occupy a lower level than the wheels.

Of General Interest.

TARGET HOLDER.—C. P. WORRELL, Zanesville, Ohio. The object of this inventor is to provide in connection with the front of the box, clamping strips to bind the edges of the target and laterally adjustable to stretch the target out, and a member closing the rear of the box to check the shot or bullets, the member being preferably in the form of a separable metal plate.

ENVELOP.—L. C. VAN RIPER, New York, N. Y. The envelop has an ungummed flap which may be held within a pocket, or removed therefrom in order to allow the contents to be inspected by postal authorities. It is provided with the ordinary gummed flap, intended to be a sealed envelop, and yet allow the same to be sent through the mail at the postage rates required for unsealed matter.

FIRE-ESCAPE.—R. W. SCHWEIMLER, Louisville, Ky. Here the intention is to provide a device in which a person may be safely transported to the ground from an elevation quickly but without injury. It provides an inclined covered chute of zigzag construction. The user is conveyed to the ground while sliding in a sitting posture.

SCREEN.—F. J. RUMBUSCH, Shelbyville, Ind. In this instance the invention pertains to screens, the more particular purpose being to provide a screen which offers a total obstruction to the passage of light through it, and in this manner improves the distinctness, clearness, and brilliancy of images thrown upon the screen.

SUBMARINE MINE.—A. P. BROOMELL, York, Pa. This invention relates to mines in which a mine is connected by a line with an anchor with means for paying out the line and for checking the paying out, so that when the mine and attached anchor are thrown overboard the mine will float as the anchor descends, and as it approaches the bottom it operates to draw the mine below the surface to an extent proportioned to the length of the gage line connected with the anchor.

EXTENSION-BOLT.—F. H. CRUMP, Los Angeles, Cal. This improvement provides an extensible formed bolt in which the solid bolt member has a threaded engagement with a hollow internally threaded cylindrical member and an outer casing or sleeve surrounding the two, so that the bolt may be shortened or lengthened by turning the first two mentioned members relatively to each other. Further extension of the bolt within reasonable limits may be made by interposing additional threaded sections.

Hardware.

FAUCET.—W. F. OGAN, Ophir, Utah. The faucet is arranged to permit the operator to quickly change the position of the working parts for opening the faucet to the full extent for the removal of a mixture of solid and liquid material or for discharging a mixture of solid and liquid material through a desired sized spout or for completely closing the faucet.

LOCKING DEVICE FOR AWNING CORDS OR STRAPS.—S. ASCH, New York, N. Y. This invention is for use in preventing mischievous children having access to awning cords. Means are provided for inclosing and locking up the lower portion of the cord or strap at the point where it is attached. By means of a key access may be had to the interior so as to adjust the awning when desired.

Heating and Lighting.

FURNACE-GRATE.—W. J. THOMAS, Salt Lake City, Utah. The invention relates more particularly to a grate in which the grate bars are utilized as conduits for the delivery of air under pressure to the burning material. An object is to so construct the parts that any one of the bars may be removed independently of the other bars and without interrupting the delivery of air through the latter.

COMBINED MATCH BOX AND CIGAR CUTTER.—E. OLDENBUSCH, New York, N. Y. The box is adapted to receive a card or package of detachably connected friction matches. It is formed of two sections movable in respect to each other and one so formed as to frictionally retain the package or card of matches in engagement therewith independently of the other section of the box which constitutes the cover.

Household Utilities.

COMBINATION CHAIR AND IRONING BOARD.—ROSE HUFFT, care of C. C. HARRELL, Port Arthur, Texas. An object of this invention is to provide a device which in its normal form constitutes a chair and which can easily be changed from the normal form into a stand such as a table, ironing board, or the like. The invention effects economy of space in a household.

CUSPIDOR.—M. D. GREEN, Flora, Ill. This cuspidor may be hermetically sealed for sterilizing purposes. An object is to provide one having a removable receptacle therein and also means whereby a sterilizing or cleansing fluid may be applied thereto. A series of cuspidors may be cleansed and sterilized simultaneously.

WINDOW SCREEN.—F. T. PETERS, Lincoln, Neb. The invention comprises a combination with a casement having sash grooves and pockets in its head and sill, the pocket in the head being in alinement with the upper sash of the receiving groove and the one in the sill in alinement with the lower sash, both slidable in the groove, of a screen resting on the upper sash and movable into and out of the head pocket, a screen detachably connected with the lower sash and movable into and out of the sill pocket, said pocket having a pan with slidable sections, the lower section being provided with an outlet.

TABLE-SLIDE.—L. A. WIEDEMAN, Louisville, Ky. In this slide the two side pieces are fastened to the respective halves of the table while the central portion is fastened to the center leg, when the sides are pulled apart the side pieces will slide relatively to the center piece, the latter remaining practically in normal position. The table may be extended until the stop members of the slides engage the end top members on the central portion. Intervening leaves may then be inserted and will rest upon the upper parts of the slide.

Machines and Mechanical Devices.

ADDRESSING MACHINE.—T. F. PLATER, Monett, Mo. This inventor seeks to provide the machine with cutting mechanism for severing the strip bearing the addresses and also seeks the provision of means for moistening the strip immediately before it is cut, the strip being provided with a gummed surface to cause the portions severed to adhere to the articles to be addressed.

PORTABLE CONCRETE MIXER.—C. W. OVERTURF, Dumont, Iowa. One object here is to provide a device in which the time during which the materials are subjected to the mixing process may be varied at will of the operator. This is done by means of a mixing cylinder through which the materials pass and which can be inclined to a greater or lesser degree, thereby increasing or decreasing the rate of travel of the charge therethrough.

CASH REGISTER ATTACHMENT.—J. R. COSBY, Richmond, Va. The present invention includes a device operated on and by a key coupler which in turn operates upon the intermediate parts to effect a movement of the advertising mechanism, which may be operated step by step to expose successively the succeeding faces or inscriptions upon the cylinder.

GLASS-MOLDING MACHINE.—W. J. MILLER, Coffeyville, Kan. This invention relates to semi-automatic glass molding machines in which a table carries a series of molds and is given an intermittent rotary movement through a mechanism including cylinders, and the patentee provides an improved valve arrangement for controlling all the different mechanisms incidental to the several operations of the machine.

Prime Movers and Their Accessories.

REVERSING TURBINE.—H. T. WEBBER, New York, N. Y. The turbine is capable of being rotated in either direction. The invention resides in the construction of the rotor which enables it to be driven by steam admitted on either side. Admitting it on one side drives the rotor in one direction and on the other side drives it in the opposite direction.

Railways and Their Accessories.

SIGNALING DEVICE.—W. F. SMITH, El Paso, Texas. In its present embodiment the invention comprises a plurality of levers arranged to display signals or be housed within a casing, and mechanism whereby the levers may be locked in either position and also means for locking the operating mechanism. Said locking mechanism may be controlled from the cab or other locality occupied by the operator.

GRAIN CAR DOOR.—J. F. McGINNESS, Harvey, N. D. In operation blocks are engaged with their respective plates, after which the door is positioned and hinged plates are turned into position against the edges of the door's inner face and locked by pins. When the car is to be unloaded the blocks are removed, and the door's lower section swings outward. After enough of the load has passed outwardly to relieve the pressure on the upper section the entire door is removed and suspended by hooks.

SWITCH ROD.—F. W. BROWN, Grenada, Miss. This invention pertains to adjustable switch rods for railroad track switches. One intention is to provide a switch rod having shoulders against which the flanges of the switch points may be firmly held, thus preventing any lateral movement of the points.

RAILWAY TIE.—J. BUTCHER, Chanute, Kan. The object in this instance is to provide a construction for ties which facilitates railway construction, provide a construction which may be in part or wholly renewed and re-used, provide a construction which lends itself to varying conditions of railroad construction while being standard in form, and provide a construction which cushions the road bed and allows for leveling the same.

FASTENING DEVICE FOR INCANDESCENT BODIES.—F. STEIN, 26 Winterfeld Street, Berlin, Germany. The invention pertains to means for fixing the incandescent body and its accessory, such as a projecting basket on the burner head or to the frame of a gas lamp for the illumination of railway carriages, in connection with which the device is especially intended to be used.

Pertaining to Vehicles.

VEHICLE CUSHION.—J. F. MOSEMAN, Donaldsonville, La. The object of this inventor is to provide a device wherein a pneumatic cushion is interposed between the body of the vehicle and the axle. The cushion may also be used with railway chairs, the legs of the chair resting upon the upper bar and the lower bar being secured to the floor.

GRIP-TREAD FOR VEHICLE WHEELS.—F. HOLAN, Niobrara, Neb. This invention refers to attachment for the rim of a vehicle wheel for the purpose of enabling it to grip the road bed. An object is to provide a construction for the device which is simple and which can be readily attached when desired to the wheel.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

TEXT BOOK OF THE HISTORY OF ARCHITECTURE. By A. D. F. Hamlin, A.M., Professor of Architecture, Columbia University. Eighth edition. New York: Longmans, Green & Co., 1909. 12mo.; pp. 467, 235 illustrations. Price, $2.

In this work Prof. Hamlin has presented an admirably concise sketch of the various periods and styles of architecture and has briefly criticised the more important works of each period or style. Despite the fact that extreme condensation in presenting the leading facts has been necessary, the work gives a very comprehensive view of the development of architecture. Not the least valuable feature of the work is the manner in which technical terms are defined and explained, together with a glossary at the end. Good judgment has been shown in the selection of the illustrations.

TIME AND TIDE. A Romance of the Moon. By Sir Robert S. Ball, LL.D., F.R.S. London: Society for Promoting Christian Knowledge, 1909. 16mo.; pp. 192. Price, $1.

This is a reprint of the second edition of "Time and Tide," which consisted originally of a series of lectures delivered before the London Institution. The book although popular presumes an acquaintance on the reader's part with such ordinary astronomical facts as may be contained in a work on so difficult a subject of comprehension as the tides. If we have any objection whatever to offer against this admirable work it is simply that it is not what is now called up-to-date. In other words, we find the subject of solid tides on the earth, that is, the displacement of the earth's crust itself, not dealt with. It seems to us in view of Dr. Hecker's recent experimental investigations of this subject and his convincing proof of Sir George Darwin's theoretical estimate of the yield of the solid earth, that it might have been wise to incorporate in this reprint these later investigations. As it is, however, the book covers the subject well and lucidly.

TWENTY-FIVE YEARS OF ROPE DRIVING. Mishawaka, Ind.: Dodge Manufacturing Company, 1909. Quarto.

It is not the usual practice of this journal to review in its columns trade publications or catalogues. In this particular instance an exception must be made because of the character of the work which lies before us. It is not only an example of admirable printing but a good piece of technical compilation. In the 104 pages of this book much solid engineering information is given, as well as an occasional useful table. The material on Features of the American System of Rope Driving, Rope Drive Designs, American vs. English System, and Mechanical Power Transmission is particularly good because it seems to state very fairly the main differences between two widely used methods of transmission.

ELEMENTS OF TRANSPORTATION. By Emery R. Johnson, Ph.D. New York and London: D. Appleton & Company, 1909. 12mo.; 360 pages. Price, $1.50.

This is a valuable discussion of steam railroad, electric railway, and ocean and inland water transportation. The author is Professor of Transportation and Commerce in the University of Pennsylvania. It has given us great pleasure to review in a short period two other books by Mr. Johnson, viz., American Railway Transportation and Ocean and Inland Water Transportation. The volume before this is fully as interesting, and these three books should be in the library of every person who wishes to keep fully apace with the times. The author's vast experience has enabled him to handle the subject in a masterly manner. The maps are particularly valuable, many of them being printed in both red and black showing the increase in mileage at various periods, and also the maps showing the various so-called routes.

DIE HAUS- UND HOTEL-TELEGRAPHIE UND TELEPHONIE. Von O. Canter. Dritte gänzlich neubearbeitete Auflage. Von Paul Riemenschneider. 143 Illustrations. Octavo. Vienna: A. Hartleben, 1909.

The book which lies before us has passed into its third edition. It is a text book for those electricians who are concerned with the installation of house telephone and telegraph systems. Since such electricians are not always technically trained men, the author begins the book with the usual popular discussion of the cause and effect of the galvanic current, electromagnetism, and induction. Then follows a description of the apparatus employed, which description is as exhaustive as possible and deals with the underlying theories of each part thoroughly. After a discussion of the simple and most common house telegraph apparatus, namely, alarms of various constructions with their accompanying circuits, we find discussion of annunciator systems and telephone and microphone inventions. The subject of house telephony is described at length, as well as suitable protective devices against atmospheric electricity. Interesting is a discussion of telltale door contacts, clock contacts, fire alarms, etc. After describing the material necessary for the installation of a house telephone or telegraph system, the author passes to the manner of installing the systems described and testing methods for the detection of injured portions. The estimate of cost given would hardly apply in this country, but serve the purpose at least of showing the relative value of different parts.

THE FORCE OF THE WIND. By Herbert Chatley. 80 pp. 12mo. Ill. with diagrams. London: Charles Griffin & Co., 1909. Imported by Lippincott. Price, $1.25.

We find in this little book collected and correlated methods of calculation of wind stresses and wind power which we have often sought with difficulty from scattered formulæ in engineering pocket books and text books, and believe that it will fill a long felt want among engineers who have to deal with wind load on structures and similar problems. The formulæ, many of which are derived by the author, are as simple as moderate accuracy will permit, and abstruse methods are introduced only where it is impossible to avoid them. The book is thoroughly up to date, including the latest results obtained by Lanchester and Eiffel, and is throughout clear and practical.

COORDINATE GEOMETRY. By H. B. Fine and H. D. Thompson. 300 pp. 12mo. 9 plates. New York: The Macmillan Company, 1909. Price, $1.60.

In this book the several conic sections are treated early and in some detail, partly because of the value of a knowledge of their more im portant properties, partly because of the advantage when presenting the analytic method to the student, of applying it in the first instance in the systematic study of a few interesting curves. In deference to usage, a chapter on the circle is introduced immediately after that on the straight line, but if experience is to be trusted it is better in a first course to proceed from the straight line directly to the parabola so that as early as possible the student may get the impression which comes from seeing a method employed in the investigation of new material. The part of the book devoted to solid geometry is more extended than is customary in elementary text books but it is desirable that the material here given should be easily accessible to students. Although intended as a college textbook the present work follows the fortunate modern tendency toward the practical and forms as good a treatise upon the subject as possible for the non collegiate student.

A MANUAL OF PRACTICAL ASSAYING. By the late H van F Furman. Revised and enlarged by W D Pardoe. 497 pp 8vo New York John Wiley & Sons 1909 Price $3

This standard work on assaying has, in the new (sixth) edition been thoroughly revised and brought up to date. The chapters on zinc water and coal analyses have been rewritten and minor changes have been made in certain parts due to the description of new methods. Because of their increasing importance commercially chapters have been added on the assay of telluride ores tungsten molybdenum, and vanadium. On the latter important subjects the reputation of the work as one of the leading text books on the subject has been completely maintained and the usefulness of the whole enhanced.

STRUCTURAL DETAILS. Elements of Design of Heavy Framing. By H S Jacoby. 368 pp 8vo 6 folding plates and 34 full page ill New York John Wiley & Sons, 1909 Price $2 25

The title of this volume corresponds to a course of instruction conducted by the author in the College of Civil Engineering in Cornell University during the past nineteen years. In this course the students receive their first instruction in the application of the principles of mechanics to the design of the details of structures. Experience has shown that in many respects problems involving timber construction are better adapted for this purpose than if confined to structural steel. It may appear at first as if too much attention to details is given in the examples on the design of joints beams and trusses. The author believes however that the importance of careful study of every detail can only thus be properly emphasized. In practice it seems to be the exception rather than the rule to give the same attention to details of timber structures as to those of steel. In the interest of sound engineering practice it is essential that all connections and details have the same degree of security as the framed members. In several articles the order of design is given in full with a view of economizing the time of the student and of promoting systematic habits in making the computations required, these objects being regarded as important elements in efficient engineering education and practice. Whereas the book is intended for college use much of it is so written as to be intelligible without the mathematics involved and valuable to the practical carpenter or builder desirous that his work shall be on sound principles or interested in the theory upon which are founded the rules of his practice.

THE INTERNAL COMBUSTION ENGINE. By H E Wimperis. 320 pp 8vo, fully ill New York D Van Nostrand Company 1909 Price $3

This is the first treatise on gas oil and gasoline engines we have seen which goes as thoroughly into the subject both theoretically and practically as do the best text books on the steam engine. The author traces the energy that drives our engines all the way from solar heat and molecular action to the uses to which the modern internal combustion engine is applied covering sufficiently the laws of thermodynamics the chemistry of combustion and explosion the best design in gas engines and producers and oil and gasoline engines. The final chapter on gasoline engine efficiency and rating is the best we have seen on this much debated question and is in so far practical and helpful to the amateur and the sportsman as to discuss the modification of accepted ratings which should be made in hill climbing and other automobile competitions.

HENRY HUDSON. A Brief Statement of His Aims and Achievements. By Thomas A Janvier. To which is added a newly discovered partial record now first published of the trial of the mutineers by whom he and others were abandoned to their death. New York and London Harper & Bros 148 pp, 12 ill, 16mo Price 75 cents.

The Hudson Fulton Celebration has aroused keen interest in the life of one of the most romantic characters among the explorers and navigators of the sixteenth and seventeenth centuries. The book before us is divided into two parts, the first consisting of a brief sketch of the life of Henry Hudson and the second dealing with newly-discovered documents. The latter have remained neglected for three centuries, and are here published for the first time. The discovery of these documents is due to Dr R G. Marsden, M.A., as a result of a search in the Record Office in London. The story of the trial is of great interest, but of little satisfaction, inasmuch as we are ignorant of what punishment if any, was inflicted upon the mutineers of the "Discovery." The importance of these documents is that they establish the fact (until now not established) that the mutineers were brought to trial, and that they embody a sworn testament hitherto unproduced, of six members of Hudson's crew concerning the mutiny. The illustrations include no portrait of Hudson since the author is satisfied that no authentic portrait of the man is in existence. Outside of the new documentary evidence above referred to, the narrative of Hudson's life is a condensation of the facts that have been recorded by Hudson's authoritative biographers, notably Purchas, Gerrits Van Meteren, Asher, Murphy, Brodhead, and Read.

MACHINE SHOP DRAWINGS. Reading Drawings, Making Shop Sketches, and Laying Out Work. By Fred H Colvin, A.S M E. F I New York McGraw, Hill Book Company, 1909 16mo, 139 pp Price, $1.

This little book is intended to be a help to those who do not thoroughly understand the reading of drawings, rather than an attempt to teach drawing in itself. It shows how seen and unseen portions are represented, the use of full and dotted lines, the way in which different views are drawn and how to study them all so as to secure a correct idea of the shape of the piece represented. Many actual examples are given from the drawing-room practice of the leading shops in this country and the meaning of each carefully explained. The book is an eminently practical one and is illustrated by well-executed engravings, the wax process, which is the only suitable one for the purpose, being used.

A Book of Fourth-Dimension Essays.

The subject of the fourth dimension seems to have aroused so much interest among the readers of the SCIENTIFIC AMERICAN that we have decided to publish in book form the prize essay, the three essays that received honorable mention and about sixteen of the best essays which were submitted in the recent Fourth Dimension Contest. The entire collection will be edited by Prof H P Manning who will prepare an introduction of considerable length in which the subject of the fourth dimension will be simply and lucidly discussed. The book will be ready about the latter part of December.

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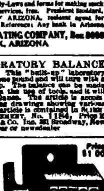

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THE 10,000-TON SUCTION DREDGER FOR USE ON THE MERSEY.

(Continued from page 334.)

Each valve is of tapered cylindrical form extending the full depth of the hopper with open-bottomed valve at the lower edge, and has a lift of four feet These valves are worked by hydraulic cylinders controlled from fore-and-aft gangways and supported by a continuous fore-and-aft girder running the full length of and above, the hoppers Guide rings efficiently stayed to the hopper sides are fitted at the upper and lower parts of the valves for steadying the same.

A surface valve with lever for opening or closing it from the gangways is fitted on top of each hoppor valve to drain off the surface water During dredging operations the mixture of sand and water is delivered into the landers and thence falls into the hoppers through the valves already described The sand settles in the hoppers while the surface water escapes aft along the waterway formed by the hopper coamings to the weir plates which can be adjusted to suit the trim of the ship and then flows overboard through large rectangular shoots two of which are disposed on each side. When discharging spoil the hopper valves are raised, and the sand rapidly falls through the openings in the bottom of the vessel

There is an indicator fitted in the chart room which shows the draft of the ship together with a complete system of repeating telegraphs and speaking tubes for transmitting orders to the pumping and propelling engine rooms and to the different winchmen in their respective winch houses Moreover there are powerful electric alarm bells fitted to the pipemen's positions Pushes are provided for each pipeman and one on the navigating bridge so as to give alarm in case of necessity

The hydraulic installation carried out by the builders of the ship comprises a set of three-cylinder inverted high pressure direct-acting engines having three cranks and three single-acting ram pumps driven direct from the piston rod crossheads The hydraulic pressure is 800 pounds per square inch and is used for working the four main sluice valves on the suction pipes at the sides of the vessel, as well as those on the delivery pipes at the ends of the landers and for opening and closing the twelve hopper discharge valves

The propelling machinery is right aft and consists of two sets of inverted vertical, triple-expansion engines of the same type as the pumping engines, each having cylinders of 22¼ inches 37 inches, and 61 inches diameter respectively by a stroke of 45 inches Steam is raised in four large single-ended marine boilers measuring 15½ feet by 12½ feet placed between the propelling and pumping engine rooms and constructed for a working pressure of 180 pounds per square inch Watertight doors controlled from the upper deck are fitted in the machinery space bulkheads to provide access from one room to another

The side compartments adjacent to the hoppers, as well as the two forward holes, are buoyancy spaces rendered necessary for the vessel to support her weight of hull plant and load on the specified draft of water

The engineers and officers are housed in the poop and the crew in the forecastle, the master's cabin being placed in a large teak house on the navigating bridge with the chart and wheel house above

The vessel is fitted throughout with a complete installation of electric light on the incandescent system The engines and dynamo are placed in the propelling-engine room The engine is of the inclosed type compound direct double-acting and coupled direct to the dynamo, which is of the direct-current compound wound pattern. The powerful windlasses, each driven by separate vertical engines

(Concluded on page 346.)

Home-Made Experimental Apparatus

In addition to the following articles, the Scientific American Supplement has published innumerable papers of immense practical value of which over 17,000 are listed in a carefully prepared catalogue which will be sent free of charge to any address Copies of the Scientific American Supplement cost 10 cents each

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THE CONSTRUCTION OF AN ELECTRIC THERMOSTAT is explained in Scientific American Supplement 1566

HOW TO MAKE A 100 MILE WIRELESS TELEGRAPH OUTFIT is told by A Frederick Collins in Scientific American Supplement 1605

A SIMPLE TRANSFORMER FOR AMATEUR'S USE is so plainly described in Scientific American Supplement 1572 that any one can make it

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EXPERIMENTS WITH A LAMP CHIMNEY In this article it is shown how a lamp chimney may serve to indicate the pressure in the interior of a liquid to explain the meaning of capillary elevation and depression to serve as a hydraulic tourniquet an aspirator and intermittent siphon to demonstrate the ascent of liquids in exhaustive tubes to illustrate the phenomena of the bursting bladder and of the expansive force of gases Scientific American Supplement 1583

HOW A TANGENT GALVANOMETER CAN BE USED FOR MAKING ELECTRICAL MEASUREMENTS is described in Scientific American Supplement 1584

THE CONSTRUCTION OF AN INDEPENDENT INTERRUPTER Clear diagrams giving actual dimensions are published. Scientific American Supplement 1615

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and connected by compound positive clutches at both crank and main shafts, are fitted on the forecastle head for working the anchors

The steam steering is of the Caldwell combined steam and hand type with control shafting to the steering standard on the navigating bridge and is placed in the engine-room casing Hastie's hand screw steering is fitted aft immediately over the rudder head for use in case the steam gear breaks down On the starboard side a motor launch is carried under Welin bow davits ready for immediate use for taking soundings or making observations

◆

SOME CURIOSITIES OF INVENTION.

(Concluded from page 33?)

by cork bulwarks b We wonder if the inventor really believes in the efficacy of the hand-operated screw propeller which he has provided

The Society for the Prevention of Cruelty to Animals would undoubtedly interest itself in restraining the inventor who devised the arrangement here shown to enable a dog or cat to run a sewing machine We once heard of a man who patented a contrivance for driving a coffee mill by means of a bicycle so that by the simple contrivance of riding a bicycle it was possible to obtain not only a certain amount of exhilarating exercise but also to provide enough ground coffee for breakfast This patentee surely outdoes him The dog is made to rotate a central shaft carrying a large gear wheel which meshes with a small bevel gear carried on the sewing machine driving wheel It seems to us that after the dog had sewed one shirt he would be too dizzy to do much more or perhaps when that occurs the central shaft is to be driven in the opposite direction

A grain of common sense is to be found in the trunk that becomes its own luggage trolley for it must be confessed that the ordinary trunk when full is not the easiest thing in the world to handle The inventor has provided a single wheel and a folding lever handle which serves the purpose of pushing the wheeled trunk along He evidently was not concerned much with the problem of the amount of space consumed by the wheels and the handle when folded within the trunk

The handle shown for carrying parcels used in carriages has been employed in European railways The device consists simply of two straps and a rest board with the whole easily detachable Straps serve the purpose of binding the rest board and walking sticks and umbrellas together

A boat driven by windmills is certainly a mechanical curiosity Just why this complicated arrangement of bevel gears connecting the propeller shaft with the vertical windmill shaft should be better than canvas transcends our imagination

There is a touch of the Yankee in the fishing device the last of the inventions illustrated Evidently the inventor was accustomed to fishing in streams where bites were few and far between and where patience was ill rewarded He has contrived a fishing pole with a swinging arm carrying a clapper which is made to ring a bell as soon as a fish bites and swings the arm down

◆

BIRDS OF PASSAGE

(Continued from page 335)

of the return of the same individuals Some wonderful European records of the return of a species to a given nesting site are given by the late Prof Alfred Newton A common falcon *Falco peregrinus* a cosmopolitan bird commonly known as the duck hawk in this country had its eyrie at one point in Finland for 110 years that is to say there was at this same point an occupied nest of this species from 17?6 to 18?5 At Oxbridge in one or the other of two earthen bottles placed for their use a pair of blue titmice had their nest every year with two

(Concluded on page 342)

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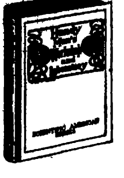

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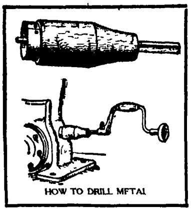

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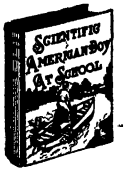

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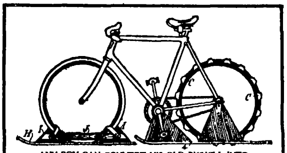

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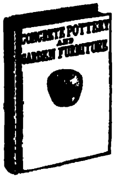

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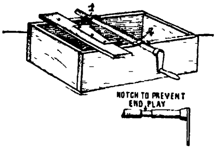
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(*Concluded from page 340.*)

exceptions, from 1779 or 1785 to 1873, or a total of 88 to 94 years. While it might be possible that by coincidence the individuality of this continuous tenantry would continually vary, yet it is hardly possible that it was other than a case of a family castle handed down to posterity.

A fact which is incidentally brought out by these observations on the return of birds to a given locality, is the apparently passionate fondness for a given nesting site, regardless of changing conditions in connection with it. In illustration of this the author just quoted cites the case of a stone-curlew, *Œdicnemus crepitans*, a bird frequenting open places almost exclusively. For many years a pair of these birds had a nest at a certain spot near Elwedon, Suffolk, England, and during this period the environment underwent a complete change from a barren rabbit warren to a flourishing plantation, in the center of which the nest continued to be occupied. An even more remarkable example of fondness for a certain spot, regardless of change of conditions, was brought to the attention of the present writer several years ago. A portion of Long Island City, within the greater city of New York, was being built up on filled in marsh. During the fall and winter a plot of ground was filled in and a house built thereon. The following spring a Florida gallinule, *Gallinula galeata*, was repeatedly observed wandering disconsolately back and forth across the dooryard, seeking the site of last year's nest, though all about were patches of virgin marsh.

It seems quite possible that this fondness for a breeding home, once established, may be an important factor in the causes of migration.

Here, then, are some of the facts that command attention in the results of the data that has been accumulated regarding migration, the impulse to migrate, for which we have no adequate and demonstrable explanation; the stability to steer a course with such remarkable accuracy over areas where landmarks are wanting, and in the night and storm when they are obliterated, demonstrating a most highly developed sense of direction which is but imperfectly present in the wildest races of mankind, and usually almost or entirely wanting in civilized man; the adoption of certain well-defined migration routes both in the Western and Eastern hemispheres, which may be varied from spring to fall, or become changed by untoward conditions; the existence of this migratory instinct in varying intensity, which, coupled with conditions of food supply and breeding sites, induces in some species immensely extended journeys, from which there is every gradation to the species which are apparently immune to the promptings of this instinct. In connection with this last fact it should be borne in mind that the fact of a species being found in a given locality throughout the year does not necessarily imply that the individuals of that species are not migratory. The individuals found in a locality in winter may have summered further north, and coming to that locality in fall, overlapped the departing summer birds, so that at no time individuals of the species were wanting, though not at all times the same individuals.

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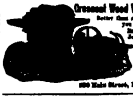

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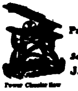

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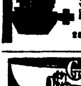

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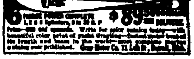

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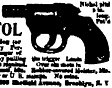

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(*Concluded from page 336*)

penetrated into the specimen As it is desired to ascertain this with considerable accuracy, it is necessary to magnify the displacement of the rack. This is the office of the pinion and indicator The dimensions of these are so arranged that a fall of 0 1 millimeter (=0 0039 inch) will correspond to one division on the dial.

Penetration at most temperatures is permitted for just five seconds. At the beginning the reading of the dial is noted, and also at the close. The difference will show the amount of penetration in terms of tenths of a millimeter But if the test is made at the freezing point of water or at a lower temperature, the penetration is allowed to continue for a full minute. The weight carried by the needle is not always the same For temperatures that do not rise above 32 deg. F, the weight is 200 grammes At 77 deg. F it is 100 grammes. For a temperature of 100 deg. F or higher, the weight is reduced to 50 grammes. As the apparatus depending upon the needles weighs just 50 grammes apart from the weight *W*, the requisite variations in load are readily made

The question arises here however, as to whether there is any point of view from which the amounts of penetration at the various temperatures may be regarded as comparable Thus Mr Dow gives the penetrations of three different asphaltic cements, A, B, and C, as follows

PENETRATION NUMBERS

Temperature.	A	B	C
32 deg F	10	13	25
77 deg F	55	47	45
100 deg. F	150	110	75
115 deg. F	350	220	120

The amount of penetration of A at 32 deg F is 10, at 77 deg F it is 55 But are the cases comparable? Can we say with an justice that the viscosity in the one case is 5½ times that in the other? The penetration of 55 was accomplished with half the load and in one-twelfth the time. Offhand it would seem that the number 55 should be 24 times as great.

There are, however, two other influence at work—one tending to make the number 10 too large the other tending to reduce it Falling bodies—and such a body the penetrating needle is—do not have a uniform velocity but become accelerated On the other hand, as pointed out by Mr S Whinery, the depth of penetration is not a measure of the work done, the needle being in fact of a conical form. The farther the penetration, the greater the amount of material displaced, and the greater the frictional resistance (due to adhesion) per unit of penetration However, it is conceivable that the form and material of these counteracting factors might be so adjusted as to nullify each other

With the disturbances arising from acceleration and from variation in resistance eliminated, there still remains the apparently faulty method of varying the weights and the time It would seem better to maintain these factors precisely the same, or else correct the numbers so as to have them comparable, whatever the temperature However, the Dow machine has, apparently, proved itself of great value in actual practice. An improved machine has recently been put on the market, in which the framework arrangement supplying weight for the needle is entirely discarded, being replaced by a tube containing the weight and holding the needle This tube slides in a guide-arm supported by a substantial upright The extra weight, as may be seen in the engraving, is placed low on the tube, and so will tend to deflect it but little, if at all. The table carrying the specimen is supported by a screw arrangement. This enables the specimen to be brought into contact with the needle at zero position. The mirror, seen at the bottom of the apparatus, enables the operator to determine when contact between needle and specimen has been secured The counterbalancing arrangement used in the Dow apparatus is replaced by the pressure of a spring The remaining features are essentially the same The rejection of the framework device weighting the needle and the string counterbalance would seem to be steps in advance especially if the replacements will yield as good results

A practical word may be added as to the results shown in the table of penetrations The cement A is regarded as showing as great a variation as is safe for pavement use A greater variability in viscosity at the different temperatures would be difficult if not impossible in practical application If soft enough for 32 deg it would be too soft at high temperatures C shows a steadiness which would be valuable if it were not for an accompanying bad quality Its ductility (at 77 deg F) is but 20 while A is 300 B shows less variability in viscosity than A and more than C Its ductility (at 77 deg F) is 75

The susceptibility to change in hardness resulting from application of heat or to ageing may be ascertained by utilizing the penetrometer

It will be seen from a consideration of the facts which have been recounted that the tests for ductility and viscosity are of great practical utility

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Trigger mechanism, F. R. Williams	938,102
Trigger mechanism, single, J. H. Robinson	[illegible]
Trolley, O. W. [illegible]	[illegible]
Trolley pole, J. Larsen	[illegible]
Trousers, J. H. Sprague	937,886, 938,147
Trow[illegible], [illegible] Nerup	938,070
Truck, S. [illegible]	938,301
Truck lateral motion roller bearing device, [illegible] Butler	[illegible]
Trunk tray support, C. F. [illegible]	[illegible]
Tube mill cement feed, [illegible] Sparrow	[illegible]
Tunnel [illegible], F. W. [illegible]	[illegible]
Turbine, elastic fluid, J. Hodgkinson	[illegible]
Turbine, elastic fluid, S. Z. de Ferranti	[illegible]
Turbine muffler and fly wheel combined, J. A. Lawson	[illegible]
Typewriter attachment, W. A. Tompkins	[illegible]
Typewriter keyboard lock, W. F. Kidder	[illegible]
Typewriting machine, A. J. Brewer	[illegible]
Typewriting machine, A. W. Steiger	938,178
Typewriting machine, Tanner & Jones	[illegible]
Typewriting machine, J. B. Secor	[illegible]
Typewriting machine, F. D. Broughton	[illegible]
Ultramarines, manufacture of, [illegible]	[illegible]
[illegible], J. [illegible] Manning	[illegible]
Valve, H. [illegible]	937,[illegible]
Valve, J. Schreiter	[illegible]
Valve, C. Wainwright	[illegible]
Valve, air brake safety, O. Gibson	[illegible]
Valve, barrel, [illegible] Forney	[illegible]
Valve, check, H. F. Cunning	[illegible]
Valve, [illegible], W. Ohlson	[illegible]
Valve gear, A. M. Wolf	[illegible]
Valve gear for explosive engines, A. A. Kaucher	[illegible]
Valve, pressure regulating, H. F. Cunning	[illegible]
Valve, safety gas, F. D. Gregory	[illegible]
Valve, vacuum air, C. A. Dunham	[illegible]
Vapor former, R. C. [illegible]	[illegible]
Vault, burial, H. Lanius	[illegible]
Vault, burial, C. Hess	[illegible]
Vehicle brake, R. R. Hart	[illegible]
Vehicle dumping, C. Miller	[illegible]
Vehicle fender, C. W. [illegible]	[illegible]
Vehicle [illegible]	[illegible]
Vehicle motor [illegible]	[illegible]
Vehicle reach, M. R. Hall	[illegible]
Vehicle ventilator, [illegible] Harvey	[illegible]
Vehicle wheel, E. Hartman	[illegible]
Vehicle wheel, F. [illegible]	[illegible]
Vehicle wheel, L. M. Wilson	[illegible]
Vehicle wheel, W. D. [illegible]	[illegible]
Vending machine, coin controlled, H. A. [illegible]	[illegible]
Vending machine, coin controlled, [illegible] J. Fritsche	[illegible]
Vending machine, picture, [illegible] McQuillan	[illegible]
Vent, sanitary, W. S. [illegible]	[illegible]
Ventilator. See Vehicle ventilator	
Ventilator, H. F. [illegible]	[illegible]
Vibrating [illegible] and separating table, J. [illegible]	[illegible]
Violin tuning peg, J. Rose	[illegible]
Voting booth, F. [illegible]	[illegible]
Voting machine, J. H. Dean	[illegible]
Wagon brake, F. A. Johnson	[illegible]
Wagon runner, F. Kindahl	[illegible]
Wagon wheel, [illegible] & Byers	[illegible]
Wagon stock loading attachment, farm, F. X. La [illegible]	[illegible]
Wall, retaining, M. M. [illegible]	[illegible]
Warp carriage, H. D. [illegible]	[illegible]
Warp frame, W. F. Derr	[illegible]
Washboard, J. F. Byers	[illegible]
Washer, H. A. [illegible]	[illegible]
Watchmaker's tool, C. H. [illegible]	[illegible]
Water [illegible] apparatus, [illegible]	[illegible]
Water elevator, F. Montgomery	[illegible]
Water heater, electrically operated, [illegible] Honnewell	[illegible]
Water heating apparatus, [illegible]	[illegible]
Water purifying apparatus, [illegible]	[illegible]
Water tube boiler, H. F. Ely	[illegible]
[illegible], W. C. F. Bent	[illegible]
Weight indicating [illegible]	[illegible]
Welding machine, [illegible]	[illegible]
Wheel, [illegible] Stewart	[illegible]
Whe[illegible], H. [illegible]	[illegible]
Whiffletree [illegible]	[illegible]
Wind[illegible], [illegible] Hull	[illegible]
Wind[illegible]	[illegible]
Wire stretcher, W. W. Snyder	[illegible]
Wire stretcher, J. R. [illegible]	[illegible]
W[illegible], J. [illegible]	[illegible]
Wood preserving, [illegible]	[illegible]
Wrench, D. W. Shaffer	[illegible]
Wrench, C. [illegible]	[illegible]
Wrench, R. D. Hamilton	[illegible]
Wr[illegible], H. J. [illegible]	[illegible]
Yoke, neck, C. F. Wheeler	[illegible]

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V The Handling and Shipment of Iron Ore.—The above-mentioned fact that iron ore is mined in the middle West and smelted in the East has necessitated not only the construction of special freight-carrying steamers, but also the designing of special machinery for loading and unloading the ore from the steamers.

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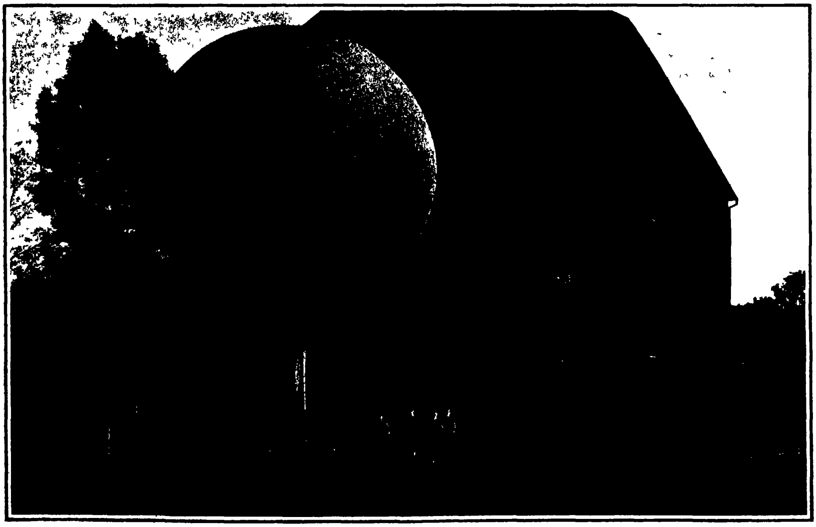

The balloon house at Fort Myer, Va., with signal corps detachment and hydrogen balloon No. 9

OUR AERONAUTICAL ORGANIZATION.—[See page 350.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

LOCAL MAGNETIC DISTURBANCES AND THE GENESIS OF PETROLEUM.

In a bulletin recently published by the Geological Survey, Mr George F Becker ingeniously inquires whether there is not a hitherto unsuspected relation between magnetic disturbances as manifested by the compass needle and petroleum deposits. Any such attempt must necessarily be based on some definite theory of petroleum's origin. Accordingly Mr Becker summarizes the condition of knowledge with reference to the origin of petroleum and other bituminous substances. The result is thoroughly unsatisfactory. Some oils are undoubtedly organic and some are beyond question inorganic. The evidence shows that neither variety can properly be regarded as unimportant. Mr Becker's review, however, does not elucidate the source of the principal deposits, the great petroleum pools. They may have been derived from carbonaceous matter of vegetable or animal origin, and they may have been derived from carbides of iron or other metals. It is also barely possible that the hydrocarbons exist as such in the mass of the earth.

In thinking over this situation it occurred to him to inquire whether any relation could be detected between the behavior of the compass needle and the distribution of hydrocarbons. Not very much could be expected from a comparison of these phenomena, for magnetite exerts an attraction on the needle whether this ore occurs in solid masses or is disseminated in massive rocks, and again, many if not all volcanic rocks possess polarity so that repulsions are involved as well as attractions. Even if the iron carbide theory of genesis were known to be correct, and exclusively correct, no one would think of maintaining that all bodies of magnetite have a connection, however remote, with the occurrence of petroleum. Hence any indications of iron carbides and associated petroleum which the compass might be supposed to afford would be obscured by the local attraction of independent masses of magnetite. Earth currents are also to some extent local and thus produce irregularities in declination.

Nevertheless, irregularities of the curves of equal declination on Bauer's map of the magnetic declination in the United States, are strongly marked in the principal oil regions. When this map is compared with one prepared by Mr David T Day showing in detail the known hydrocarbon deposits of the United States the coincidences recognized become more striking and other agreements become evident.

The most marked agreement is found throughout the great Appalachian oil field which is the area of greatest variation in declination. In California, also, strong deflections of the isogonal lines accompany the chain of hydrocarbon deposits. In the interior of the country the coincidences are less marked, but they are very noticeable.

There are other systematic irregularities, wrinkles in the isogonic topography which can not be connected with oil. One such wrinkle runs down the Atlantic coast and contains the New Jersey native iron as well as known deposits of magnetite. Another lies near latitude 37 deg. and is doubtless due to the great northern iron belt.

No detailed chart of the magnetic declination in the petroleum fields of the Caucasus has yet been prepared. Mr Bauer states that great magnetic disturbances exist in that region, [illegible] similar to those in this country are probable.

On the whole, coincidences between the occurrence of petroleum and local disturbances of the compass needle are too numerous to be attributable to mere accident or chance. There must therefore be a direct or an indirect historical connection between the two phenomena in the regions of coincidence.

No one doubts the vast industrial importance as well as the deep geological interest of the petroleum question. As time elapses it will grow more and more important, for the pinch of dwindling coal resources will probably affect children of those already born. In the interest both of the development and the conservation of our natural resources all the means at the command of science should be brought to bear on this mysterious subject. A geologist and a chemist each of the highest order should be coupled in the long and difficult investigations needed to elucidate the genesis of petroleum. The initial expense would be considerable, but the ultimate economy would be enormous.

THE FIFTH VANDERBILT CUP RACE AND THE GOOD ROADS TOUR FROM NEW YORK TO ATLANTA.

It is seldom that the public has an opportunity to witness notable speed and reliability contests contemporaneously, but such was the case this year when the Vanderbilt cup race was run on Long Island on October 30th, while the reliability tour promoted by the New York Herald and the Atlanta Journal was also being conducted.

Although the race has lost much of its former glamor through the substitution of high-powered stock chassis for the huge racers that used to compete, it nevertheless gives a good idea of the speed and endurance qualities of the machines that are being regularly produced for the market.

The fifth annual race was run over a 12.64-mile course, which included the cement motor parkway upon Long Island, and consisted of 22 laps (278.08 miles). There were 15 competitors, while the four stock cars that took part in the Wheatley Hills Trophy race and the six in the race for the Massapequa Trophy, both of which were run simultaneously, made a total of 25 machines that were traveling around the course at the start. The two secondary races were 189.6 and 126.1 miles in length respectively, and were for cars of smaller horse-power and lighter build.

The Vanderbilt race was won by the 60-horse-power 6-cylinder Alco car driven by H F Grant. The time was 4 hours, 25 minutes, and 42 seconds. The average speed maintained was 62.77 miles an hour, as against 64.38 made by Robertson last year on a better course with a 120-horse-power Locomobile. During the last four rounds an average of over 70 miles an hour was maintained, the last one being covered in 10.33 at the rate of 71.9 miles an hour. This machine—an improved American model of a well-known French car—has always done well in all contests in which it has been entered, and it was not at all surprising that it should win America's premier racing event.

The only other car to finish was Parker's Fiat, which averaged 61.55 miles an hour. Only two other cars—an old Mercedes and the two-cycle Atlas—were running at the end. This is said to have been due to the use of the motor parkway as more than half the course, which was only half the length of those used in previous years. The cement surface of this road has slight undulations that make it a very severe test of both tires and mechanism. Two cars broke their steering knuckles, four had cracked cylinders, and three sustained a broken crankshaft, a broken rear axle, and a damaged radiator, respectively.

The 189.6-mile race was a walkover for Harroun on a Marmon, as the three other cars in the race lost many minutes making repairs, and one of them withdrew when the race was half done. The average speed of the winner was 59.76 miles an hour.

The 126.4-mile race was won by a Chalmers-Detroit 30-horse-power car in 2 hours, 9 minutes, 58 2/5 seconds at an average speed of 58.4 miles an hour. Two Maxwell machines were second and third with an average of 51.1 and 50.4, respectively, while a 20-horse-power Hudson secured fourth place with a 50-mile-per-hour average.

The reliability tour which was promoted for the purpose of spreading the good roads doctrine by giving the farmers of the South an ocular demonstration of the value and usefulness of the automobile, especially where good roads obtain, was carried out with marked success. Forty-seven cars left New York on the morning of October 25th and covered the 1,150 miles of varying kinds of roadway passing through nine States and leading to Atlanta in ten days without serious trouble. Twenty-six of these machines made the journey on schedule time with a perfect score. They were divided into six classes, ranging in price from [illegible] down to $850. The Maxwell runabout was the [illegible] prize-winning representative of the [illegible]. This reliability [illegible] newspapers, [illegible]

[illegible]

[illegible]

It is a somewhat singular fact that [illegible] household beverages, coffee, tea, and cocoa, [illegible] an alkaloid, a poison. In small doses these alkaloids have a certain stimulating effect upon the system, and it is presumably on this account that the beverages which contain them have acquired such popularity. At the same time there seems to be no reason for [illegible] that these beverages act as aids to the digestion, and the fact remains that the alkaloids of coffee, tea, and cocoa are toxic substances. Their ingestion in excess may become harmful even to strong and healthy persons. For this reason endeavors have been made to find suitable substitutes, which should possess the advantages and pleasing properties of our common household beverages, but free from the poisonous constituents which these latter contain.

We must look to special processes of treatment of ordinary coffee for our supply of a non-toxic product free from alkaloids. One such process, the product of which is upon the market, consists first in a preliminary treatment of the coffee beans, whereby their cell tissue is loosened. They are next subjected to the action of acid or alkali, and the caffein can then be extracted with a volatile solvent, such as benzene, ether, chloroform, petroleum ether, etc. The residue of solvent left in the material after the extraction is expelled by treatment with high-pressure steam or in vacuo.

A new process, invented by Prof. Kippenberger, who has abandoned his patent claims and made the method public property, consists in treating the coffee with oil, and subsequently with acetone or glycerine.

The inventor has found that caffein is insoluble in oil at ordinary room temperature, but is readily soluble in hot oil. Furthermore, caffein tannate, which is present in coffee side by side with free caffein, while practically insoluble in ether, benzene, and chloroform, is readily soluble in glycerine and acetone.

The new process accordingly consists in treating the coffee with fatty oils (glycerides) at temperatures and pressures at which the glycerides are not decomposed. After this step the coffee is freed from adhering liquid in any suitable manner, e. g., by centrifugal action. The oil may be freed from caffein either by simply allowing it to cool, when the alkaloid is precipitated, or by extracting with a suitable solvent. After this treatment the coffee still contains a small proportion of caffein, namely, that which is present "bound" in the form of tannate. This can be eliminated by treatment with glycerine or acetone or both. If preferred this step can be carried out before the treatment with hot oil. The temperature in this latter should not exceed 160 deg. C., for decomposition of the glycerides must at all events be avoided.

In place of the glycerides (oils) it has been found that quite a large number of other substances can be used. One condition which they must satisfy is that they should be liquid at say 100 to 150 deg. C. Among substances may be mentioned the aliphatic hydrocarbons, and those of the aromatic series; also derivatives of the latter, especially their alkyl and chlorine substitution products, further the higher alcohols, ethers, and esters, such as amyl alcohol, amyl ether, and ethyl acetate. But none of these substances is quite as well adapted as the glycerides for the extraction of the caffein, as they leave a residue behind the complete elimination of which is attended with some difficulty.

The treatment with oil does not only extract the caffein, but also certain resinous substances. As the result of this the taste of the coffee is improved. In the case of tea the conditions are less fortunate. Here the process causes the loss of certain of the constituents which impart its characteristic aroma to the tea. The results of the extraction of coffee with glycerine and acetone also are not entirely satisfactory. To an expert taster the product appears not quite [illegible]. To the ordinary consumer, however, it is quite indistinguishable from the natural untreated ware.

The principal object of a recently designed clock is to show at a glance, says the Journal of the Royal Society of Arts, the time all over the world. In front of it a dial is mounted, which revolves with the [illegible] once in 24 hours, having the hours 1 P. M. till 12 midnight, and 1 A. M. till 12 noon, painted on its outside edge, the hours being divided into intervals of [illegible] minutes each. In the same plane as the [illegible]

[illegible] the Subway and [illegible] New York [illegible] the Hudson- [illegible] passengers being carried [illegible].

[illegible] engine has been designed by [illegible] and T. C. Aveling, intended [illegible] which prevent such engines [illegible] by the shaft of a vehicle, as in [illegible] engine.

[illegible] now made in the Panama Canal [illegible] September last is 17,172,658 cubic yards, [illegible] three hundred yards short of one-[illegible] the total excavation required. As the average [illegible] excavation is over 100,000 cubic yards, it may [illegible] be said that half the work was done by the end of the first week in October.

The hurricane in New Orleans on September 30th [illegible] an interruption in the operation of the pumps of the drainage system, owing to their being electrically operated and the overhead transmission line being blown down. Temporary wires were strung up [illegible] on telegraph poles, and pumping resumed in [illegible] hours, but it is now proposed to build a duplicate transmission line, and eventually to put the whole of it underground.

In connection with the landing of the Cunard steamers at Fishguard in Wales, the Great Western Railway of England has put on a new special train to London, which has been making remarkable time. On a recent run a train with a total weight of 300 tons was drawn by the new engine "King Edward" from Fishguard to London, 261 miles, at an average speed, including one stop of four minutes, of 61.3 miles per hour.

An improvement much needed elsewhere also is being tried by the Chicago Railways Company for the forced ventilation of street cars. A double ceiling is used with a number of openings like those of a hot-air heating system, the space between upper and lower ceiling acting as an exhaust duct. Fresh-air intakes are cut through the floor near the sides of the car, the screened air admitted passing through electric heaters under the seats before entering the interior of the car.

A remarkable piece of work was done by Messrs. David Rollo & Son of Liverpool in the fitting of a new high-pressure cylinder of improved design to the steamer "Star" of New Zealand The vessel being engaged in the meat trade, it was desired if possible that the change should be made in the time required to discharge her cargo at Liverpool; and although it involved the machining and fitting of all auxiliary parts, it was completed in five and one-half working days.

One of the unusual features of the work on the Ashokan reservoir in the Catskills is the use of special steam rollers for "puddling" the earth fills on either side of the concrete core-walls of the dikes. Over six million cubic yards of earth must be spread in six-inch layers, moistened and rolled, eventually forming a dam 200 feet high in places and four miles long, so the work of the rollers is considerable. They have corrugated front rolls and cross-cleats on the rear rolls, so as to thoroughly knead the moist earth, and each covers the work done by thirty men, a dozen teams, and a cableway, and is guaranteed against breakdown in continuous work for seven years.

In the House of Commons recently the question was raised as to whether the Home Office would consider the question of compelling tramway authorities to fix on their cars a device for making a continuous noise when the speed exceeds a certain limit, as is now done in the case of motor omnibuses. Mr Masterman replied that the question was under consideration, but the application of the device to tramcars presented special difficulties, owing to the varying limits of speeds authorized for tramways. Mr. Myer asked if Mr. Masterman was aware that some of the cars on the Thames Embankment traveled at a speed of over 20 miles per hour, but no answer was given.

[illegible] much favorable comment in the engineering press upon the completion, in six months less than the specified time and well within the estimated [illegible], of the widening of Blackfriars Bridge in London. The bridge, which is [illegible] years old, consists of five [illegible] arches ranging in span from [illegible] and [illegible] piers founded on [illegible] with concrete, the original [illegible] removed and the [illegible] completed [illegible]

ELECTRICITY.

It is reported that a series of wireless telegraph stations are to be installed in Siberia which will enable the War Department of Russia to keep in communication with the easternmost parts of the empire. These stations are to be large enough to operate over a radius of a thousand miles.

It has been suggested from time to time that the air in the subway could be rendered less obnoxious by supplying each car with apparatus for producing ozone, but the mere conversion of oxygen already in the subway into the form of ozone would not solve the difficulty. What is needed is a fresh supply of oxygen to take the place of that consumed by the passengers and converted into carbon dioxide. A recent editorial in the Electro-chemical and Metallurgical Industry calls attention to the system of Dr R. Von Foregger, who a few years ago proposed the use of fused sodium peroxide. Water added to this chemical would cause the production of sodium hydroxide and would liberate oxygen The sodium hydroxide would then absorb the carbon dioxide of the air and thus in addition to furnishing a fresh supply of oxygen it would purify the air as well.

Strange as it may seem to the uninitiated, the cost of operating an electric car depends to a large extent on the motorman. The economical motorman will permit his car to coast whenever possible and in this way will effect a considerable saving of power Each application of the brakes means a waste of power Recently an apparatus has been devised for keeping a record of the periods of coasting of different cars. The device is connected both with the electrical controller and with the air brakes and operates only when both the controlling apparatus and the brakes are in the 'off" position. The record is made on a paper ribbon driven by a clock. This record makes it possible to judge of the relative economy of different motormen operating on the same line and encourages them to let the cars coast whenever it is possible to do so without falling behind their schedule.

One of the main advantages of electrifying a railroad system lies in the fact that instead of having a large number of portable power plants represented by the locomotives, all the different power units are brought together in one central station and thus considerable economy is possible, if for no other reason because a separate reserve power is not required for each train. The same argument applies to the centralizing of central power stations. Instead of having different concerns manufacture their own electricity the power could all be generated in one large station Recently the New York Edison Company has offered to furnish power for the Broadway-Lexington Avenue subway The Edison Company points to the fact that it is well equipped to furnish the power required and has an adequate reserve to meet all demands.

Replying to the popular demand that the Illinois Central Railroad should electrify its terminal in Chicago, President Harahan points out the fact that electric traction is still in the experimental stage and that little as yet is known of the use of electricity for handling freight. The Illinois Central is obliged to interchange trains and cars with other roads and considerable inconvenience would be occasioned by the use of electric traction in its freight yards. He also suggests that the smoke nuisance could be eliminated by other means, and until a comprehensive plan has been developed for electrifying all the railroads that enter Chicago it would be impracticable for the Illinois Central to make a change in the power it uses. The railroad is making experiments with cars operated by gasoline engines and is testing the use of coke instead of soft coal. As a matter of fact, the railroads of Chicago contribute only a small portion of the smoke that clouds the city However, the City Council is considering an ordinance which will compel every railroad in Chicago to use electricity

The extensive use of trackless trolley cars in continental Europe has led British manufacturers to make experiments with a view to producing a type particularly adapted to the requirements of their own traction systems. Recently a car has been developed which possesses many very interesting features. Chief of these is the trolley head and its connection to the car. A three-wire system is used, the current being collected from two outer wires while a central wire takes the place of a ground. The head is supported in a horizontal position by means of a sort of parallel-ruler connection, there being two poles connecting it with the roof of the car. The head can be converted into a single-pole trolley head whenever it is desired to run the car on a track system, and in this case the ground is taken care of by a pair of shoes which ride on the rails. The overhead wires are so arranged that they can be adapted for a track system at a minimum [illegible] whenever the traffic makes such a change [illegible], it is merely necessary to remove the outer wires and leave only the central trolley wire.

SCIENCE.

Jean Comandon announced before the Academy of Sciences on October 27th the development of a new method of photographing bacilli by the combined use of an ultra-microscope and a cinematograph.

After examining the documents presented for consideration by Lieutenant-Commander Peary, the National Geographical Society has reached the decision that he reached the North Pole, and has decided to award him a gold medal for his exploit.

A cablegram has been received at Harvard Observatory from Kiel stating that Winnecke's comet was observed by Pons of Laplata, Oct 31 d 5040 Gr M T. in R. A. 17 h 11 min 51 6 sec Dec. —27 deg 18 min 43 sec The comet is visible in a small telescope

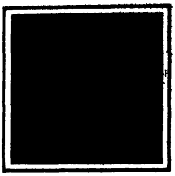
Prof. Metchnikoff, as our readers well know, advocates the drinking of much fermented milk to check the intestinal putrefaction of food and thus prolong life In furtherance of his end bonbons have been prepared consisting of a lactic acid product surrounded by a sweetened chocolate coating The sugar of the coating assists in lactic-acid fermentation.

An alloy which may have a considerable value for steel processes is now manufactured in the electric furnace in France. This is the mangano-silicide of aluminium formed of manganese silicon, and aluminium, containing generally from 1 to 2 per cent of iron and 0 25 per cent or less of carbon Sulphur and phosphorus are practically absent The new alloy has been found to answer very well as a de-oxidizing agent in steel making During the refining it is transformed to silicate of manganese and aluminium, giving a very fusible slag which is easily separated from the melted metal It is claimed that the steels which are obtained by the process are very homogeneous and are free from porosity The proportion of the new alloy is about as follows Manganese, 75 per cent, silicon, 37 per cent, and aluminium 18 per cent In the steel process, 100 parts of alloy combine with 71 parts of oxygen to give 171 parts of slag

The $1,000,000 given by John D Rockefeller will go a long way toward eradicating the 'hookworm" The worm was identified in 1903 by Dr Charles Wardell Stiles of the Rockefeller commission Soil pollution is responsible for the existence and spread of the worm It can be eliminated from the human body by a simple treatment of thymol and Epsom salts the patient in most cases being cured in several days. Pronounced anemia is the chief symptom of persons afflicted with the hookworm disease, accompanied by emaciation and great physical weakness Laziness, mental lassitude, and stupidity are other symptoms. Uncinariasis is the technical name for the disease Hookworm disease was probably known to the Egyptians near 3 000 years ago, but its cause was not understood until about the middle of the nineteenth century The hookworm is about half an inch long It lives in the small intestine.

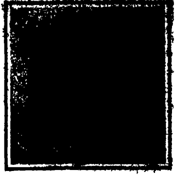
Once it was possible to buy radium at $2 a milligramme, now the market price is $90 a milligramme, equal to $2,500 000 an ounce. This was one of the striking statements in a very interesting speech delivered by Sir William Ramsay at the foundation stone laying ceremony of a new radium factory in Limehouse, an eastern suburb of London The British Radium Corporation, which is going to extract radium from pitchblende found in the Trewith mine, Cornwall, is believed to be the first company in the world to attempt the production of the precious mineral on a commercial basis It is one of the romances of science that the material in the old days was regarded by the Cornish miners as a nuisance, for it prevented them from obtaining copper from smelting. For a long time it was cast on the dumps or left underground. To-day the comparative value of crude pitchblende ore is far in excess of the gold quartz of Johannesburg or the blue earth of the diamond mines.

The swamp potato (*Solanum Comersonii*) which grows wild in Uruguay has lately been cultivated in France, where it has produced a variety with violet tubers. The new variety is characterized by extraordinary productiveness, resistance to disease and frost and the production of large aerial tubers in the axils of the leaf stalks German potato growers, however, find the new variety so similar to the long-known variety "Paulsen's Blue Giant" that they are inclined to think that the latter has, innocently or designedly been exploited in France as a novelty The same opinion is held by a prominent English potato grower The two sorts have also been cultivated side by side at the experiment station of a Swedish society for the improvement of moors, where they appeared to be identical in foliage, flowers, and tubers The swamp potato, however, proved less productive than the old Blue Giant, and its most strongly emphasized peculiarities, antipathy to lime and preference for marshy soil, could not be detected. Similar results were obtained on an experimental plantation in Silesia.



ARCHAEOLOGICAL RELICS FROM THE SEA.

BY FERDINAND WORTHINGTON



In 1907 a Greek sponge-fishing craft discovered three miles off the coast of Madhia between Sousse and Sfax at a depth of about 150 feet the wreck of a vessel some 100 feet long and 20 feet beam The cargo of the sunken vessel consisted of sixty columns of white marble arranged in six rows the columns being topped with Corinthian or Ionic capitals and otherwise painstakingly and artistically carved Furthermore there were several statues.

M A Merlin Director of Antiquities of Tunis has advanced the theory that the vessel was an ancient galley which had left Greece bound probably for Italy Contrary winds had driven it on the coast of Tunis where it foundered at a time which may be approximately placed at about the beginning of the Christian era

The relics which have been brought to the surface from this ancient wrecked ship are undoubtedly of Greek origin Several bronze statues have been recovered One of them a figure of Eros is thought to be a replica of the Eros of Praxiteles There is also a Hermes of Dionysus fragments of candelabra and of beds also a statuette about 14 inches high which might have served as a lamp for the head is hollowed out to form an oil well

The marble relics are more numerous than those of bronze They comprise capitals of various decorative designs drinking cups embellished with Bacchic bas-reliefs which remind one of the celebrated Borghese vase of the Louvre statuettes busts and the like. One column which was brought ashore measures 13½ feet in height, and nearly 2 feet in diameter at the base

It may be stated that this artistic treasure trove of the sea was recovered at the expense of the Tunisian and French governments the Académie des Inscriptions et Belles Lettres and several wealthy gentlemen The French navy assisted in bringing the material to the surface. The divers employed were Greeks who had forsaken their calling of sponge fishing to devote themselves to the more artistic vocation of fishing for statues All the objects which have been recovered will eventually find a placé in the Bardo Museum at Tunis.

◆

A Pure Air Law for Workmen.

BY G. M. RIPLEY

It costs money to purify anything Whether it be the Panama Zone that must be made habitable or a political situation which requires a housecleaning all of these worthy enterprises require considerable expenditure and there will always be found some who protest Even our worthy pure food law came in for its share of complaint and now we learn that the New York labor law requiring a supply of fresh air for the employees of workshops and factories is being subjected to some criticism

The law reads as follows

The owner agent or lessee of a factory shall provide in each work room thereof proper and sufficient means of ventilation and shall maintain proper and sufficient ventilation if excessive heat be created or if steam gases vapors dust or other impurities that may be injurious to health be generated in the course of the manufacturing process carried on therein the rooms must be ventilated in such a manner as to render them harmless so far as is practicable

Mr William W Walling chief factory inspector for the State of New York interprets the law as follows

As defined by Dr John S Billings perfect ventilation means that any and every person in a room takes into his lungs at each respiration air of the same composition as that surrounding the building no part of which has recently been in his own lungs or those of his neighbors or which consists of the products of combustion generated in the building while at the same time he feels no currents or drafts of air and is perfectly comfortable as regards temperature being neither too hot nor too cold. How much air is required to meet these conditions? Not less than 2,000 cubic feet per hour for each person, with the same amount per hour for each cubic foot of gas consumed whether for light, heat, or power

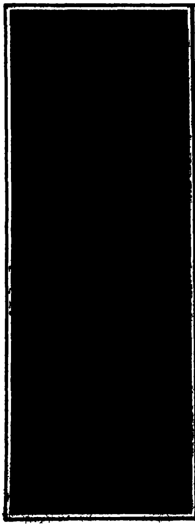
Some landlords in New York city have put forth the claim that the amount of fresh air specified by the Department of Labor was an arbitrary quantity " Several authorities on the subject of ventilation who have been consulted in the matter and who are also entirely disinterested agree that 2 000 cubic feet per hour per person is common practice and is based upon definite laws or rules which have been followed for many years in the design of ventilating systems

The Architects and Builders Pocketbook " written by Mr Frank E Kidder C E Ph.D states (and this book is an authority and therefore a record of current practice) that 1 800 cubic feet per hour per child should be the standard for school buildings this amount being required by law both in Massachusetts and New York. It further states that in buildings more closely packed and occupied for a longer period the air supply should be from 2 000 to 2 500 cubic feet per hour per person In giving an example of a school room of certain dimensions he shows that the standard amount of air would result in the air in the room being changed about eight times per hour—which certainly does not appear to be an excessive amount

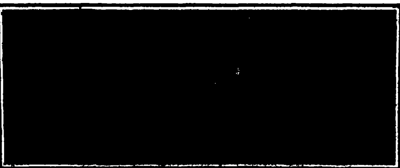
Since the above applies only to buildings where people sit quietly or for buildings where only children congregate it is difficult to see how the representatives of the New York Department of Labor can justly be accused of any arbitrary action in interpreting the meaning of proper and sufficient ventilation

Mr Percival Robert Moses consulting heating and ventilating engineer of New York city states that he has found the rate of 2 000 cubic feet per hour per person a satisfactory and conservative working basis

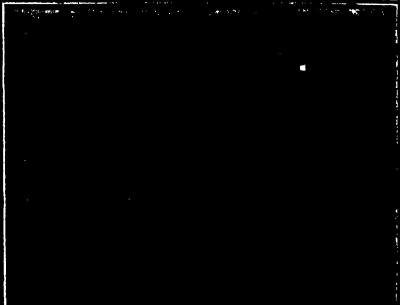
In a loft 25 feet wide and 100 feet long containing



A bronze Hermes.



A marble Ionic capital.



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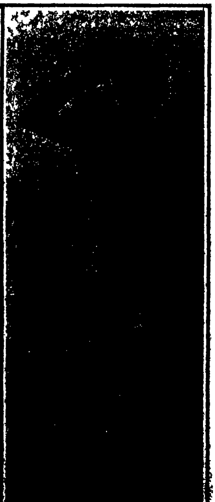

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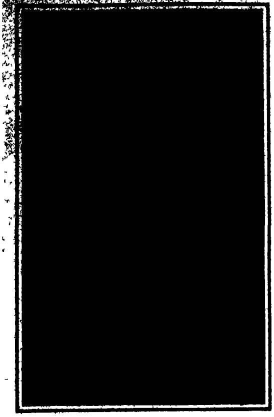


Fishing for archæological relics.

80 workmen, and lighted with electricity, the amount of air required would be 80 × 2 000 = 160,000 cubic feet per hour This amount of air per hour would move at the rate of about ⅛ of a mile per hour, and would be sufficient to change the air in the loft six times per hour, assuming a 10-foot ceiling Since the Massachusetts and New York State laws for school rooms require eight changes per hour, and since some authorities recommend even 50 per cent in excess of this, it appears that the action of the factory inspector hardly comes within the definition of the word "arbitrary" which in the Standard Dictionary means "done capriciously" or "without adequate determining principle," or "non rational," not done according to reason or judgment, depending on the will alone, tyrannical, despotic, not fixed by rule

The operating cost for a ventilating system is made up of two items (1) Power for turning fans, (2) additional heat for incoming air In a loft building where the tenant will pay for the power, the expense will automatically be divided and the landlord will pay for the extra heat required, since heat is included in the rent. It will also be noticed that again the adoption of electric lighting will cut the bills for operating expense to a remarkable degree. This cut in expense will affect the tenant, since a much smaller ventilating motor will be required, and it will also affect the landlord because less air will have to be drawn in, and hence the cost for heating would be diminished

In large systems the services of an expert heating and ventilating engineer would probably prove valuable, and it is possible so to design the equipment that a judicious "recirculation" of the air from halls and basements will effect an economy in the fuel bill This air is seldom impure and requires much less heat than if cold air were brought in from outside It is also possible in buildings where high-pressure steam is available, or where boilers which have been run at low pressure can be run at a higher pressure, to adopt the following policy: Provide steam engines to operate the fans and turn the exhaust steam into the heating coils—thus getting a double use out of the steam and cutting down the electric bill. This idea could be carried still further in many instances, and economies could be made (especially in the winter) by abandoning electric pumping, again lowering the electric bill. This is the stock argument of the advocates of isolated plants, who contend that great economies result in buildings of a million cubic feet or more if engines are installed and electricity is made on the premises. It is a fact that steam at high pressure only contains about 6 per cent more heat than steam at low pressure. Thus the argument that electricity can be made and a building heated with exhaust steam is advanced. The layman does not appreciate one very peculiar fact about steam: that at five pounds pressure it is only about 6 per cent cheaper to make than at 100 pounds pressure, showing that the cost does not increase in proportion to the pressure.

[illegible]

of this character has recently been completed in New York city, in which the landlord at the time of construction had the ventilating system installed at his expense, after the design of a prominent consulting engineer Thus the cost of operating a system and the responsibility of maintaining it in good condition does not rest upon the tenant

It is natural during this transition period and before the betterment of the standard of building construction has become general, that some differences are bound to arise between the Factory Inspection Bureau and the landlords and tenants. It is to be hoped that this condition is but temporary

In the report of the United States Bureau of Labor at Washington, D C., it is shown that deaths among factory workers due to consumption, were divided as follows

Employees exposed to metallic dust	36 9 per cent
Employees exposed to mineral dust	28 6 per cent
Employees exposed to vegetable fiber dust	24 8 per cent
Those exposed to animal and fiber dust	32 1 per cent

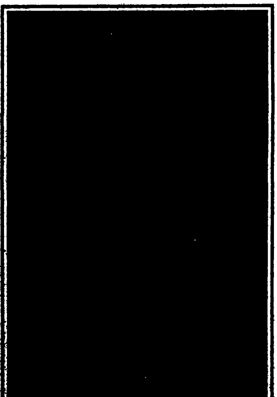
The occupation showing the highest consumption mortality was grinders, among whom 49 2 per cent of all deaths were from that disease

An ingenious conclusion was reached by Mr Frederick L. Hoffman, of the Prudential Life Insurance Company, based on this report. It is his opinion that by intelligent methods of ventilation and dust removal the consumption death rate among the wage earners would result in an annual saving of 22,238 lives. This would add, quoting the Engineering News, 15 4 years of life for every death from consumption avoided by rational conditions of industrial life Such a gain would represent a total of 342,465 years of additional lifetime, and by just so much the industrial efficiency of the American nation would be increased Placing the economic value of a year's lifetime at only $200 the total average gain to the nation would be $3 080 for every avoidable death of a wage earner from consumption, representing the enormous total of $68 493 000 as the annual financial value clearly within the range of practical attainment. Therefore nothing within reason should be left undone as a national, State, and individual or social duty to prevent that needless but now enormous loss of human life from consumption due to the unfavorable conditions in American industry

None will deny that the efficiency of workmen varies with their good health and comfort Slight physical ills are prevented by better surroundings, and the loss to the employee due to absences, or brain made stupid by breathing foul air, are immediate losses to the employer through lowered efficiency, and later involve a loss of trained employees and the necessary breaking in of green help

The Technical Utilization of Platinum.

Platinum is one of the most important substances used in modern industry Its resistance to attack by strong sulphuric acid makes it a suitable material for the vessels employed in concentrating the dilute acid of the lead chambers, and until recently, states



[illegible] [illegible], a fragment of a marble vase.
[illegible] [illegible] from the silt.

Bronze lamp

Lmachau platinum vessels were always used for this purpose Its permanence in the air makes it suitable for contacts in electric bells induction coils and the like its resistance to the action of chemical reagents causes platinum to be employed in the construction of crucibles, evaporating dishes scale pans, etc, as well as electrodes for experimental and technical electrolysis. Platinum is little affected by heating to a very high temperature and it is consequently used in the construction of electric resistance furnaces, in which temperatures exceeding 1 800 deg F are attained and in Le Chatelier's pyrometer for the measurement of high temperatures. Another property of platinum which is of great practical importance is the approximate equality of its coefficient of expansion by heat to that of glass or porcelain A platinum wire fused into a glass vessel will not produce cracks or leakage by unequal contraction in cooling or unequal expansion in subsequent heatings. This property is utilized by the makers of incandescent electric lamps, the carbon filaments of which are connected with the external circuit by short platinum wires, fused through the glass bulbs For a similar reason the attachments of artificial teeth are made of platinum wire which is baked with the porcelain mass in the kiln Finally the catalytic properties of platinum are utilized in various chemical industries especially the production of sulphuric acid by the contact process, and in the construction of self lighting gas burners etc

The Rising of the Aral Sea.

The rise which has been noticed in the Aral Sea is a difficult one to explain It will be remembered that this body of water is one of the greatest lakes in the world, and in some places it has a depth of 220 feet It receives the water of two large rivers the Amu Daria and the Syr Daria which bring to it about 2 000 cubic yards per second During the last century it appears that the level of the lake has varied considerably Starting from the middle of the century, we find that the level was lowered during 30 or 35 years, and this condition prevailed until after 1880, bringing about changes in the contour of the lake and the islands became larger However we find that in 1899 when Berg explored the lake, it was now rising and had reached a much higher level, so that it overflowed some of the islands and these had to be abandoned On shore the railroad tracks had to be moved The rise in the lake lasted until 1908 and we find that from 1880 to 1901 the level of the lake rose about 6 6 feet Besides the Aral Sea we find that other lakes of the same region have also risen, so that the region of central Asia is far from undergoing a gradual drying up as was supposed Given the mean depth of the lake as 52 feet, the rise of 6 6 feet gives the addition of a mass of water representing one-eighth of the lake's contents. At the Barnoul observatory the rainfall is found to have kept at about the same point since 1877 so that we are at loss to explain the rise of the lakes in this region In ancient epochs we find similar phenomena in different lakes as determined by geologists but like the present one they appear to be unexplained

OUR AERONAUTICAL ORGANIZATION.

BY C. H. CLAUDY

Except for sporadic experiments, as at Fort Myer last year for all the majority know to the contrary, the United States has done nothing in aeronautics. But the impression is erroneous. We have done all that we could do with the money there was available—more indeed, than anyone thought we could.

Just what is our status, aerially, to-day?

To begin at the beginning, the aeronautical work of the government is all in the hands of the Signal Corps, an arm of the service charged with obtaining and conveying information, and opening lines of transmission of intelligence Within the Signal Corps, of which Brig-Gen James Allen is chief, is the Aeronautical Division This includes a number of officers, of whom Lieut Frank P Lahm is chief, under Gen Allen, and enlisted men in squads of varying proportions, depending on the work to be done. Major G O Squiers is the theoretical expert. The strange proportion of men to officers of about two enlisted men to each officer which obtains is explained by the fact that the enlisted men do nothing but erect the balloons or act as laborers for the towing or holding of aeroplanes. It is the officers alone who do the flying and to whom is intrusted the actual aerial work. An exception to this was found last year when on the death of Lieut. Thomas Selfridge in the Wright accident and before Lieut. Lahm could get to St. Joseph, Mo, where the dirigible was located, Sergt. Ward went up in the dirigible with Lieut. Foulois and while without experience succeeded in operating the steering end with credit

By name the officers in the aeronautical corps are Lieut. Frank P Lahm Major George O Squiers Lieut Benjamin D Foulois Lieuts. Winters, Bamberger and Dickenson Capt Charles De F Chandler is attached to the Signal Corps now as disbursing officer but is available for aeronautical duty at any time. Of these officers, Lieut. Lahm has had the greatest experience and he and Capt Chandler are the two licensed pilots Lieut. Foulois made a record with the dirigible last year Winters, Bamberger, and Dickenson have each made a few flights in free balloons, but are still beginners in the art of aviation Major Squiers has made an exhaustive study of the theory of aviation of all kinds and is an authority on the subject, although his practical experience is limited to a couple of balloon and one aeroplane trips.

The equipment with which the Aeronautical Division has to work comprises a balloon house at Fort Myer and a balloon house of much greater capacity at Fort Omaha, where is also located a large electrolysis plant for the decomposition of water and the collection and storage of hydrogen, and the compression of it into steel tubes, for transportation The Aeronautical Division has a number of spherical balloons, one dirigible, and will have at least one and possibly two aeroplanes before another year being under contract to accept one from A. M Herring and the Wright brothers, each, if they can satisfy the tests and conditions laid down by the Signal Corps in their original specifications.

The present equipment of the Aeronautical Division is neither large nor strong, but while it is used almost entirely for experimental and training purposes it must not be supposed for a moment that it could not be used successfully in time of war The spherical balloons, which can be used either captive or free, are just as able to take an observer aloft in time of war and for photographic or observation purposes, as in time of peace to give him aeronautical experience The dirigible while a small one—ninety feet long—has not a very large radius of action Perhaps five hours in the air would represent its extreme of endurance. Yet it is perfectly efficient for the obtaining of information at a considerable distance.

The aeroplanes will be—one of them at least—the best of their kind in the world Mr Herring's machine is a mystery and no one knows whether it will be a success or not. But the Wright machine has demonstrated its efficiency

Nevertheless, much depends upon who will run an aeroplane—as to how it will behave. The selection of Lieuts. Lahm and Humphreys to be the first aeroplane pupils is a wise one, not only because these gentlemen have had more actual aeronautical experience than anyone else in the army, but because they are both of them the type of men to make a success of any enterprise requiring quick thinking and action and cool nerves.

Perhaps the most interesting thing in connection with army aeronautics which the United States has to show, is the large balloon house at Omaha, which is capable of housing a very large dirigible, several hundred feet long, and of supplying it with gas. Just as soon as Congress sees fit to provide the money, we can immediately build a large dirigible, without having to wait for a balloon house It is unquestionable that another and much larger balloon house, similar to or larger than the one at Omaha, will be erected at or near Washington. Indeed, Gen Allen has expressed himself in favor of building it big enough to hold a Zeppelin Meanwhile, there is the plant at Omaha, ready for the big dirigible when we shall get it. At present it houses the small one. The filling of steel tubes of one cubic foot capacity with 2,000 cubic feet of gas is a regular part of the work at Omaha, so that these tubes, transported from place to place, can afford facilities for erecting and flying either spherical or the dirigible balloon. Hydrogen, of course, has so much greater lifting power than coal gas, that its use is dictated always except for balloons of large size which have not to carry much weight. The "No. 9," seen in the photograph, is capable of making a free flight with two men although it holds but 9,000 cubic feet of gas, which provides a gross lifting power of 630 pounds. The "No. 10," which has a capacity of 80,000 cubic feet, will lift more than a ton, filled with coal gas, and with hydrogen would lift 5,600 pounds. To have hydrogen easily and quickly available, anywhere at any time, is a great part of the work of the electrolysis and compressing plant at Omaha, and the possession of this plant, as well as of the various balloons, dirigibles, and aeroplanes, goes far to give the United States at least a start in aeronautics, whereas we are popularly conceded to be simply a minus quantity

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The Testing of Intelligence.

BY OUR BERLIN CORRESPONDENT

The multiplicity and diversity of those intellectual forces which individually or collectively are called intelligence is only too often under-rated. In a recent memoir, R. Stransky draws attention to the error generally made in connection with scientific intelligence tests so called, by choosing a single aspect of mental life as representative of its totality It is a common mistake to mix up scientific training with intelligence, appreciating the mental capacity of a person according to the number and character of the notions assimilated at school and outside of it. Now, though a man, by frequently using abstract notions, gives evidence of a high intellectual capacity if these notions have been created by him, or at least acquired with a great deal of mental effort, those deriving the same notions from book reading do not necessarily show any productive superiority over lay people who have no occasion to deal with the same matters.

Generally speaking, it may be said that memory is by no means the only one, and still less, the most elevated of intellectual properties which, combined, make up the intelligence of a man Again, memory is of two different kinds, possessing different value, viz., either *impressive* or *associative*, according as this faculty relates to the more or less durable impressions left by our perceptions, or to the system of intellectual associations by which new perceptions are united to the existing associative elements. Now the former kind of memory obviously is far more primitive than the other, and cannot possibly be taken as a gage of intelligence. It is, in fact, generally known that adult persons, having assimilated a large amount of associative elements, are far from being so impressive as children, whose brains are as yet new Moreover, the most intelligent persons often forget the most rapidly and absolutely what they have learned at school in a purely mechanical manner, even though these matters belong to their special branch. A celebrated physician, Dr Billroth, has said in this connection that the "really educated people are just those who have forgotten more than others." The intelligence tests recently made in different countries on subjects chosen among the lower classes, have given especially instructive results in this connection by showing the frequently startling ignorance of the most common notions in the case of an individual perfectly capable by his mental capacities of earning his living and governing his house.

To this should be added that memory is only one of the different components of intelligence, and that judgment and power of combination are particularly important among the remaining functions of our intellect. Now, in appreciating the comparative mental forces of school children, this undeniable truth is only *too frequently* neglected, classification being merely based on the matters absorbed in a more or less superficial manner by the memory of the individual, and in everyday life we are unfortunately inclined to commit the same serious mistake.

In a previous memoir, the author has pointed out the individual diversity existing in the intellectual and psychical reaction to the outside world. There are thus individuals whose inner intellectual life, in its extraordinary wealth cannot become fully evident, owing to a relative insufficiency of mental or merely linguistic manifestation. Another group comprises those who have not always at their disposal a frequently rather extensive knowledge. These individuals combine tranquillity and, generally speaking, the capacity of circumstances [illegible] knowledge [illegible] ation, [illegible] also be [illegible] traversed by thought before [illegible] there are [illegible] obstacles [illegible] the outside world as abundantly [illegible]

From what has been said will be understood [illegible] value may be ascribed to intelligence tests [illegible] cording to a given scheme with [illegible] hand, and which mainly relate to memory, [illegible] of reflection, and adaptability of the [illegible]. It would certainly be interesting to test by a [illegible] method also the capacity of those particularly [illegible] individuals whose intellectual life consists of [illegible] nation rather than reception. Some methods have already been suggested in this connection; the late Dr. Ebbinghaus thus endeavored to use [illegible] the faculty of supplementing words, and on this basis the author has developed the method of "word [illegible]tion." However, all these methods, so far from showing the comparative value of intelligence, at most yield some information as to a given intellectual capacity

* * *

Artificial and Natural Ice.

Natural ice, domestic or imported from Norway, was used exclusively in France twenty years ago. At present, three-quarters of the ice used in France is artificial, although the importers of ice have gradually reduced their price one-half. In interior French cities artificial ice has completely supplanted imported ice. Fifteen years ago considerable quantities of Norwegian ice were still brought to Paris, via Dieppe. This commerce has now entirely ceased, and Norwegian ice is used only in cities on or near the seacoast. The annual consumption of ice for cooling purposes in France amounts to 800,000 tons, of which 150,000 tons are manufactured. 4,500,000 tons of ice are used annually in the United States.

A French writer has recently suggested the imposition of a tax upon imported ice, in order to protect the manufacture of pure and wholesome artificial ice. He reminds his readers that this industry is of French origin The French physicist La Hire first succeeded, in 1685, in freezing water by means of the heat absorbed when sal ammoniac is dissolved. In the nineteenth century another Frenchman, Bourgeois, constructed the first practical ice-making apparatus. In 1875 the method of transporting food in cold storage was created by Ch Tellier

Natural ice is not wholesome, as the majority of microbes survive temperatures of from —40 to —170 deg F Many sanitary casualties have been caused by the use of impure ice. An epidemic of typhoid fever in Rennes, in 1895, was traced to this cause.

In 1892, at the instigation of the Paris health board, the prefect of the Seine issued an ordinance which restricted the use of natural ice to industrial establishments and admitted as "edible" only artificial ice made either from sterilized water or water drawn from the city mains. Hence a protective duty of 6 francs per metric ton, or about $1.20 per ton, on imported natural ice is demanded.—Cosmos.

* * *

Official Meteorological Summary, New York, N. Y., October, 1909.

Atmospheric pressure. Highest, 30.59, lowest, 29.63; mean, 30.05. Temperature: Highest, 75; date, 9th, lowest, 35, date, 30th, mean of warmest day, 67, date, 8th, coolest day, 39; date, 29th; mean of maximum for the month, 59.8; mean of minimum, 46.7; absolute mean, 53.2; normal, 55.5; deficiency compared with the mean of 39 years, 2.3. Warmest mean temperature of October, 61, in 1900; coldest mean, 50, in 1876. Absolute maximum and minimum of October for 39 years, 88 and 31. Average daily excess since January 1st, 0.7 Precipitation: 0.74; greatest in 24 hours, 0.31; date, 23rd; average for October for 39 years, 3.96. Accumulated deficiency since January 1st, 3.44. Greatest precipitation, 11.56, in 1903, least, 0.12, in 1879 Wind: Prevailing direction, west; total movement, 9,290 miles; average hourly velocity, 12.5; maximum velocity, 46 miles per hour. Weather: Clear days, 15; partly cloudy, 8; cloudy, 8; on which 0.01 or more of precipitation occurred, 5. Thunderstorms, 23rd. Frost, heavy, 29th, 31st, 30th. Fog, dense, [illegible].

* * *

An Inventors' Exhibition.

The Royal Würtemberg Chamber of Commerce is organizing a State exhibition of inventors' models to be held next year at Stuttgart. Its chief purpose is to help poor inventors who have little opportunity of bringing their inventions under the notice of manufacturers. The directors of the exhibition declare that strict impartiality will be shown in the selection of exhibits, and that none will be [illegible] worthy of serious consideration [illegible]

[illegible] BREAK.

[illegible] American

[illegible] steel, it occurs to [illegible] main springs may be be[illegible] finished; that is, be[illegible] or small pieces on the edge that [illegible] and rounded on the edge since [illegible] liability of cracks in band [illegible] is necessary to finish the edges. The [illegible] begin only at the edges, and I [illegible] more perfectly finished edge.

[illegible], Ohio. J. H. [illegible]

[illegible] AND THE BREAKING OF WATCH SPRINGS.

To the Editor of the Scientific American

Considering the subject of breakage of main springs, allow me to contribute the following:

Every watchmaker has observed that at certain times a large part of his repair work consists of replacing broken main springs. And it is often observed that the spring is broken into as many parts as there were coils in the spring, and sometimes a fracture occurs every half coil.

The writer on one occasion, while wondering at the appearance of a spring broken up into half coils, noticed that the pieces were magnetized, and made a simple experiment of determining the polarity of the pieces by bringing the fractured ends together He discovered that when the pieces were fitted together as they were in the original spring, the ends of the pieces at each joint were of like polarity. He then suspended a small soft-iron indicator from a single fiber of silk in a small material bottle, and by passing this indicator along the line of broken pieces of spring, discovered that the points of fracture were of alternate polarity This was puzzling, for the ends of the pieces at each point of fracture should be of opposite polarity

The writer has since caused a spring to be magnetized while coiled in a watch barrel, and on extending the spring found the points of polarity fixed in the spring, alternating every half coil.

Now it is evident that the repulsive force of like polarity at a point in each half coil has somewhat to do with the breaking of the spring.

When we consider that many springs, when wound up, are strained almost to the point of breaking, if we then subject them to the magnetic strain, the breaking as described does not seem so strange.

Jersey City, N J FRANK G BURCH

THE RENAISSANCE CLERGY AND SCIENCE.

To the Editor of the Scientific American

The mention of the supposed papal bull against Halley's comet at its appearance in 1456 naturally suggests the consideration of the scientific work of that time. The universities were all in the hands of the ecclesiastics. In Italy particularly practically all of the professors were clergymen. In spite of the usual impression with regard to church opposition to science, this is a great period in the history of science. Though it is not usually realized, the Renaissance affected science quite as much as it did arts and letters. During the century from 1450 to 1550 the foundation of much of our modern science was laid. In the *Archives of Diagnosis* (New York, April, 1909) I called attention to the fact that to a man of this period, the famous Cardinal Nicholas of Cusa, we owe the first hint as to the use of accurate methods in diagnosis in medicine. There were no watches, for the "Nuremberg eggs" were not made until the next century, and the taking of the pulse had been very indefinite. Cardinal Nicholas suggested that the amount of water passing through a water clock during one hundred beats of the pulse should be weighed, and compared with the amount of water that flowed through standard water clocks, in normal and abnormal cases of various kinds. He suggested that the same thing should be done for the respirations. He also declared that specific gravity in the study of the urine and blood would surely be of value. Prof. Karl Binz of the University of Bonn called attention to this some five years ago in the Berlin Medical Journal.

It seems surprising at first that such thoroughly scientific suggestions for medicine should have come at the middle of the fifteenth century. A review of the scientific situation during the latter half of the century, however, shows how natural they were. Cardinal Nicholas himself wrote a series of books on mathematics. It is in one of these on mechanics that his suggestion with regard to medicine occurs, and he touched many other important scientific questions. He [illegible] that the earth cannot be fixed, [illegible]. He denies that it [illegible]. He was quite on [illegible] rising, in [illegible] a whole chapter to [illegible]. His greatest contemporary was Regiomontanus, the father of modern astronomy. Regiomontanus introduced the use of the tangent into mathematics. He was invited to Rome by the successor of that Pope Calixtus who is said to have issued the bull against the comet, to become the papal astronomer. Cantor gives him a very important place in the history of mathematics. Antonius the Archbishop of Florence was another contemporary, and his monograph on comets contains a number of interesting anticipations of ideas that did not get into astronomy until after Galileo's time. Galileo was rather inclined to think comets appearances in our atmosphere. Antonius thought them far distant. At this time Puerbach was teaching mathematics and astronomy at Vienna, and translating the Alexandrian mathematicians and astronomers from Greek into Latin for the universities of that time. A little later Novara was doing the same thing at Padua. When Copernicus, having completed his studies at Cracow, wanted to do graduate work in astronomy and mathematics, he went down to Italy Before the end of the fifteenth century he announced his new theory of the universe. Within the same decade Columbus gave the men of his time a new world, and Copernicus what his bishop friend Ferber declared to be a new universe.

Medicine woke up as the result of the touch with old Greek medicine, just as mathematics and astronomy did. Italy was the home of graduate teaching in this as in all the other sciences. Linacre and Caius and Free from England went down to Italy to study anatomy and clinical medicine. Berengarius was teaching at Bologna, Benivieni at Florence, and Leonicenus at Vicenza, and modern medicine was receiving a great new impetus. During the century from 1450 to 1550, the Renaissance century (which we Americans should call Columbus's century) all our modern anatomy came into being. The work on it was all done in the ecclesiastically ruled universities of Italy Vesalius, Varolius, Columbus the anatomist, Eustachius, Caesalpinus, and Piccolomini, with Fallopius and many others, did their work in the peninsula. Most of them were *professors of anatomy at Rome.* Eustachius, whose name is attached to several structures in the human body, Columbus, who discovered the circulation in the lungs, Caesalpinus, who first described the circulation of the blood in the body, and Varolius, after whom important structures in the brain are named, were all papal physicians. Chemistry and pharmacology woke up in the persons of the monk Basil Valentine and his great successor Paracelsus.

To think of the latter half of the fifteenth century as a time when there was lack of interest in science or any suppression of scientific aspirations, is to be ridiculously ignorant of what actually occurred, for the chapter of the Renaissance of science when the Greek masters were rediscovered and translated for the modern world is quite as important as the story of humanism or the new learning, when the Greek literary texts touched the genius of the modern world to that outburst of new thought that made one of the most interesting periods in the world's history A little more study of science history, and not of the supposed religious history of the time shows how utterly without foundation is the squabbling over religious intolerance.

JAMES J WALSH,
Dean and Professor of the History of Medicine,
Fordham University Medical School.
New York city

A New Nitrous Product.

At Mülhausen, Alsace, there is being manufactured a new nitrous product for use as fertiliser, in the shape of a nitride of aluminium, the combination of nitrogen and aluminium being obtained by a new process invented by M Serpek. The inventor first studied the preparation of carbide of aluminium which he obtained in the form of yellow crystals by heating a mixture of alumina and carbon in the electric furnace. This carbide, like the other carbides with which we are acquainted, has the property of fixing gaseous nitrogen and thus gives nitride of aluminium To obtain an economical production of this latter, he does not isolate the carbide of aluminium, but after the formation of this body in the electric furnace it is at once mixed with a fresh quantity of alumina and is then treated with nitrogen gas. He thus obtains masses which contain 20 to 24 per cent of nitrogen, and this can be used at once as fertiliser Under the influence of atmospheric oxygen and moisture we have ammonia given off, which is transformed by bacteria into nitrates and alumina. The inventor is working the new process in a small factory which he installed, and has realized some interesting results during the last year. He now produces crystallized nitride of aluminium which has a high percentage of nitrogen—as much as 24 per cent. An advantage of his process is that we do not need to use pure nitrogen which requires an expensive plant of Linde or other machines. [illegible] gas from the producer is employed, this containing 77 per cent of nitrogen and 23 per cent carbon monoxide with a little carbonic acid. Thus we have a very simple and rapid process for the crystallized nitride, and owing to the various advantages, it may compete with cyanamide.

The Migrations of Mackerel and Herring.

Although the mackerel fishing season usually ends in *October*, thousands of mackerel have been caught after October in recent years in the English Channel In November, 1901, a bank was discovered which often yielded a catch of six tons in two or three hours. Several similar winter assembling places have since been discovered It had previously been assumed that mackeral seek the North Atlantic in winter, and return in spring to the North Sea and the coasts of Cornwall and Brittany, but these new discoveries indicate that they do not migrate but simply seek greater depths in the same locality for their winter resting places, where they remain assembled during the day At night they disperse in search of food and are consequently seldom caught in the nets

Localized schools of herring have also been discovered in recent years. There may be migratory schools as well, observes Prometheus, but it appears certain that the herring is a more sessile fish than has hitherto been assumed During its first year or until it attains a length of 4 or 5 inches and probably until its length has increased to 8 or 9 inches, at the end of the second year, it remains near the place of its birth After the second year it begins to appear sporadically At all seasons the waters of the English Channel contain adult herring which are evidently of the same breed with the young fry of spring Even in winter a few herring are caught but only at great depths, although large numbers are caught near the surface in summer The assumed migration of herring to Arctic waters is made doubtful by the discovery of these sessile schools. This discovery also explains the existence of the distinct local races which are recognized by the fishermen, and which always reappear on the same fishing grounds at the brooding season

"Cork Metal"

BY F J WILLOTT

At one of the recent aeronautical exhibitions samples of a metal were shown under the name of "cork metal," which was said to be 40 per cent lighter than aluminium, and to have numerous other properties which should make it a rival of the latter

Great secrecy was maintained as to the nature of this wonderful metal, but its properties were such as to rouse my interest, as a consequence of which I have submitted it to chemical analysis.

In appearance the metal resembles very strongly the alloys known as magnalium The surface presents a lusterless whitish gray color, both sheets and bars showing the scorings and scratches so frequently found on badly rolled or drawn aluminium Careful analysis gave the following result

Aluminium	0 04	per cent
Iron	0 017	per cent
Zinc	0 48	per cent
Sodium	0 21	per cent
Magnesium	99 30	per cent

It will be seen therefore that essentially "cork metal" is nothing but magnesium to which a small amount of zinc has been added Whether this latter has been purposely introduced or, as is more probable, is merely present as an impurity I am unable to say

As the metal evolves hydrogen when immersed in water, I found it necessary to use organic solvents for the determination of the specific gravity In alcohol this was found to be 1 762, thus confirming the conclusion that cork metal is, in fact magnesium —Chemical News.

The Current Supplement.

Of the two chief constituents of the atmosphere, we have hitherto been accustomed to look upon oxygen as the fundamentally important element. Nitrogen however is of vital importance, so important in fact that the task of finding out and opening up new sources of nitrogen compounds has become one of the most interesting and pressing problems of the day The subject is well discussed in the current SUPPLEMENT, No. 1767 by Mr A. Bernthsen The Schneider torpedo-testing station is elaborately described and illustrated Mr Snowden B Redfield describes the making of automobile tires. The stars are due to fall on the nights of November 12th to 14th a fixture in the celestial schedule of events. The display is called the Leonid shower, and is discussed in the current SUPPLEMENT A new gas-electric motor car for the Third Avenue Railway Company of New York city is illustrated The article on the Paris Aviation Exhibition is concluded The usual engineering notes electrical notes, and trade notes will be found in their accustomed places.

MAKING ALCOHOL FROM WOOD WASTE

A middle West industry for which a great future is promised is that of the manufacture of alcohol from sawdust shavings slabs and other refuse of the lumber mill

Rumors of improved methods and great economies in the manufacture of wood alcohol have been in the air for some time and we have received a number of inquiries on the subject from subscribers and correspondents We are glad therefore to be able to give now some details of the new process for which patents have recently been granted to Mr Malcolm F Ewen and Mr George H Tomlinson of Chicago.

It has long been known that ethyl alcohol and other valuable by-products could be made from wood waste in laboratory experiments and many processes have been developed but practically none of them has reached the stage of economic success on a commercial scale

One of these aroused the interest of Mr John M Ewen better known as a constructional steel work engineer and manager of the Fuller Construction Company builders of so many skyscrapers Although it was not found practicable commercially Mr Ewen was so much impressed with the possibilities of cheap alcohol from wood waste that he spared enough time and energy from his other great responsibilities to continue independent investigations, and it is largely owing to his personal and financial support that the present successful process has been developed, one of the patentees being his brother

Lumbermen have long been alive to the necessity of finding a use for the appalling piles of waste they are compelled annually to destroy if only as a means of additional profit before the question of conservation of natural resources became of national interest In addition there are many and various uses to which alcohol is applicable with advantage and from which it has hitherto been excluded by its cost

All kinds of internal-combustion engines for instance can use alcohol as fuel with advantage over gasoline and with very little modification

One of the greatest advantages of the production of a pure alcohol from wood however will be the release for food purposes of the millions of bushels of corn and barley now consumed in the manufacture of grain alcohol

The price of grain alcohol is at present $2 60 a gallon at 188 proof of which $2 07 is internal revenue tax the net wholesale price being only 53 cents Corn worth 26 cents is required for the manufacture of a

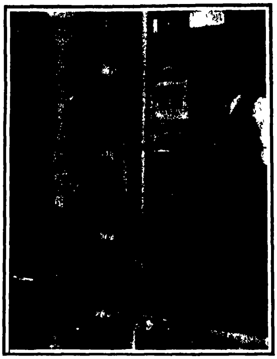
(Continued on page 359)

A diffusing battery of four units.

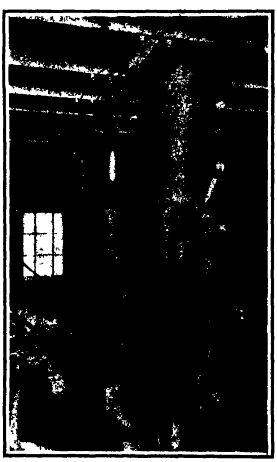
One of the large tanks in which the wood pulp is fermented.

The digesting machine which performs the functions of a mechanical stomach. It converts the starch of wood waste into sugar

MAKING ALCOHOL FROM WOOD WASTE.



Reading the thermometers.



Still by which a fine grade of ethyl or grain alcohol has been made out of sawdust and slabs

TRIALS OF THE NEW "DREADNOUGHT"—"NORTH DAKOTA."

In view of the fact that the first two "Dreadnoughts" to be built for the United States navy are identical in everything except motive power, the 'Delaware" being driven by reciprocating engines and the "North Dakota" by Curtis turbines, an unusual amount of interest has been aroused by the recent speed trials of these two ships The "Delaware,' which was built by the Newport News Shipbuilding Company, was tried out over the course off Rockland, Maine She is equipped with Babcock & Wilcox boilers, and in the five trial runs for standardization of her propellers, which were made over the mile course, she developed a maximum speed for one mile of 21 98 knots, a mean speed for the five runs of 21 44 knots, a maximum horse-power of 30 000, and a mean horse-power of 28 578

The North Dakota' is not only an exact duplicate of the "Delaware in the form of her hull and in the displacement but in common with that ship is equipped with fourteen Babcock & Wilcox boilers. Consequently, the Navy Department was in a position to make a most exact comparison of the efficiency of the respective motive power all the conditions except

(Continued on page 360)

Length, 518 feet, 9 inches. Beam, 85 feet, 2½ inches. Mean draft, 27 feet. Displacement on trial, 20,000 tons. Speed on trial, 21.86 knots. Horse-power, 33,875. Coal supply, 2,500 tons. Armor: Main belt, 10 inches to 12 inches and 7 feet 6 inches wide upper belt, 10 inches to 8 inches and 8 feet wide, barbettes and turrets, 11 inches. Armament: ten 12-inch forty-five caliber guns fourteen 5-inch fifty-caliber guns.

UNITED STATES BATTLESHIP "NORTH DAKOTA", FASTEST "DREADNOUGHT" AFLOAT

The Wright Brothers and Their First American Pupils.

On November 4th Orville Wright arrived at New York fresh from his exhibition flights at Berlin and at Potsdam before the Emperor and Empress. During his stay he taught several army officers how to operate his biplane These machines are now being manufactured in Germany, England, France and Italy, and a large company is about to be organized to make them in the United States.

Wilbur Wright has finished teaching Lieuts. Lahm and Humphreys the operation of the new government biplane at College Park, Md The aerodrome is located beside the tracks of the B & O Railroad, some eight miles from Washington and in the course of the lessons the aeroplane had several brushes with the express trains all of which it is reported to have won easily An important modification was made a month ago by Wilbur Wright. This consisted in removing the upper surface of the front horizontal rudder and rigging it just in front of the rear vertical rudders as a tail It is said to make the machine much easier to control and also that it does away to a large extent with pitching Orville Wright changed in a similar manner the machine that he used in Germany

After being taught for a fortnight how to operate the government biplane Lieuts Lahm and Humphreys on October 26th made their first flights in it alone Lieut Humphreys made the first flight, which consisted of two circuits of the field, in 3 minutes. Lieut Lahm next flew six times around and described some small circles as well his time being 13 minutes. Lieut Humphreys then made another flight of 8 minutes On October 30th both officers had been flying for 10 minutes when the gear that drives the magneto dropped off causing the engine to stop The machine glided safely to earth On November 1st after making an excellent 16-minute flight Lieut Lahm remained aloft 58½ minutes Two days later Lieut Humphreys with Lieut Foulois as passenger, flew 61⅓ minutes and came within 10¼ minutes of equaling Orville Wright's record flight with a passenger Lieut Lahm after one false start succeeded in making an 8¾ minute flight with Lieut Sweet who weighs 185 pounds and whom Wilbur Wright had twice tried to take up in a calm without accomplishing it Lieuts Humphreys and Foulois made another flight of 25 minutes. On November 5th when Lieuts Lahm and Humphreys were making a flight early in the morning the motor began missing and the machine got dangerously near the ground The end of the lower plane struck in making a turn and the machine was rather badly smashed, although neither of its occupants was hurt

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An Electrolytic Scrap Tin Process.

The electrolytic method for extracting tin from scrap is quite extensively used in Italy at the present time An alkaline bath is used in most of the factories For the anode tin scrap is used while the cathode is made up of plates of iron The bath is a soda lye which is kept at a high temperature Oxidation of the tin at the positive pole produces stannic acid which is transformed to stannate of soda by combination with the soda of the bath This stannate of soda is reduced at the negative pole and here the tin is deposited Soda is re-formed in this way

Considered theoretically the electrolysis should have the effect only of depositing the tin at the negative pole, while leaving iron at the positive pole, the liquid of the bath not changing in composition and no gas being given off at the electrodes It was found however that a heating of the bath gave a much better result which is explained by the lowering of the electrical resistance when the temperature rises and by the greater solubility of the stannic acid in the caustic soda at high temperatures Thus in order to facilitate the chemical and electrolytic phenomena the liquid is heated and given a rapid circulation in the direction of the current The reactions are easily produced at the positive pole owing to the great surface of contact of the anode and the bath but such reactions are less easily produced at the cathode whose surface is much smaller Therefore at the beginning of the operation there is formed an excess of stannate of soda and its quantity keeps on increasing When the percentage of stannate exceeds a certain value determined by experience the bath is not sufficiently alkaline to allow of the good progress of the actions Some of the liquid is then removed and replaced by soda lye When the operation is well carried out there is but little hydrogen set free at the negative pole and nearly all the oxygen enters into reaction at the positive pole The amount of gas given off shows an indication as to the working of the process and the end of the extraction of the tin coincides with the greatest disengagement of gas.

In Italy the tanks generally used are made of iron and have about 100 cubic feet capacity The liquid is made to circulate rapidly between the re-heater and the tanks by a pump The six anodes which are used are formed by perforated iron holders containing the tin scrap, while the seven cathodes are made of plates of iron. The tin is thrown down on the cathodes in a spongy state which adheres but slightly and can be collected by scraping off. The powder thus secured is washed and then compressed in cylindrical cakes, which are kept under water in order to prevent oxidation. The cakes are melted in a furnace of the kind which is used for bismuth A part of the tin is oxidised during the operation The metal is then recuperated by a reducing treatment of this oxide in a reverberatory furnace.

The iron obtained at the cathode does not contain more than 0.1 per cent of tin when the process is well carried out, and this iron is of a very good quality and is sought for by iron works. It is this part of the process which makes the present method of tin extracting economical, for unless the iron can be used in metallurgy the case would be otherwise, as is true for other tin extraction methods. The stannate of soda taken from the bath is then transformed to bioxide of tin, and to carry this out we filter the liquid taken from the tanks and a current of carbonic-acid gas is passed through it. There is formed thus carbonate of soda and stannic acid, and this latter is roasted so as to give bioxide of tin, this product being used in ceramics and also in the chemical industry for manufacture of tin salts At present there is used in Italy from 50 000 to 60,000 tons of tin, the greater part of which goes to the manufacture of tin cans. The scrap is estimated at 11 000 tons. As soon as the new works are completed, the whole of this amount of scrap can be treated in Italy

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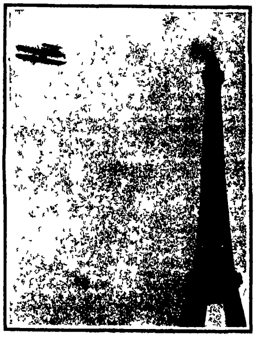
THE RECORD FLIGHTS OF COUNT DE LAMBERT AND HENRY FARMAN

Mention has already been made in these columns of the magnificent flight of Count de Lambert on a Wright biplane from the Juvisy aerodrome to Paris and above the Eiffel Tower In the present issue we reproduce a photograph showing the aeroplane flying near the tower at a high elevation After circling about the aerodrome a couple of times in order to reach a height of some 450 feet, Count de Lambert left it at 4 37 P M on October 18th and flew straight for Paris, passing over Chevilly and Villejuif and entering the city by passing over bastion 81, about 180 feet to the left of the Arcueil gate. From this point he curved to the left and kept steadily ascending, so that when he reached the Eiffel Tower he was at a height of some 400 meters (1,312 feet), or 100 meters (328 feet) above the top of this lofty edifice. After passing over it he described a wide semi-circle, and returned to Juvisy along the same route He alighted at 5 30 P M less than a score of feet from his shed, and was heartily cheered by the crowd of spectators who had witnessed his departure and return. The total length of the flight was 49 minutes 39 seconds, and the distance covered close to 30 miles. The air-line distance from the aerodrome to the tower is about 12½ miles, but the course followed by Count de Lambert was a couple of miles longer, to which must be added the circuits of the aerodrome at the start and upon the return When congratulated upon his magnificent performance by Orville Wright (who had just arrived from Berlin), Count de Lambert was very modest and had but little to say. The chief impression was the slow speed at which he seemed to be traveling when flying at a great height, and the well-nigh interminable time before he finally reached again his starting point. Although his flight was one of the most daring [illegible] [illegible] Count did not [illegible] it an [illegible] [illegible] [illegible] [illegible] [illegible] in aviation it stands [illegible] [illegible] purpose. Although Farman's new [illegible] [illegible] made at Mourmelon November 3rd, [illegible] [illegible] more importance from a practical point of view.



COUNT DE LAMBERT FLYING NEAR THE EIFFEL TOWER.

While competing for the Michelin trophy [illegible] Wednesday, Farman flew continuously for 4 hours, 6 minutes, and 25 seconds, during which time he covered 232 kilometers (144 miles) at an average speed of 35.08 miles an hour Thus he has actually covered in a single flight a distance as great as that from New York to Albany, which we stated some time ago we believed him capable of covering if he had seen fit to revisit America and participate in the contest held during the Hudson-Fulton Celebration. This contest, which is for a prize of $10,000 for the first aeroplane or dirigible that flies from New York to Albany, is to be held open until October 9th, 1910.

The motor used by Farman in his latest record-breaking flight is the same one that he used in winning the long-distance contest at Rheims. It is a Gnome revolving-cylinder motor of 50 horse-power, having 7 cylinders that revolve in a vertical plane around a stationary crankshaft. In a brake test made by the Aero Club of France, this motor developed only 34 horse-power and ran for 3½ hours; Farman has had however, greater success with it, as evidenced by his excellent flight. Both Paulhan and Sommer, as well as Farman, have also made excellent flights recently upon Farman biplanes at the recent aviation meetings at Blackpool and Doncaster in England The revolving-cylinder motor seems to have worked well in every instance, and to have demonstrated its reliability

The Michelin trophy was brought to America last week by the president of the Aero Club of America as a result of Wilbur Wright's flight of 2 hours 20 minutes on December 31st last at Le Mans. When asked whether he thought it would remain here, Wilbur Wright is said to have replied that the winner for this year must be prepared to fly from dawn till dark, so in all probability Farman's record will be considerably beaten before the year is out.

As the trophy can only be competed for between 10 A. M. and sunset, however, if the flight for it is not made until the last day of the year, it cannot be of more than of six or seven hours' duration.

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Disinfectants in Water Purification.

At the annual meeting of the New England Water Works Association one paper dealt with the extensive studies which have been in progress for some years at the Laurence Experimental Station, and another recorded some interesting results obtained at the Poughkeepsie water works. At the Laurence establishment many disinfectants have been tested, including copper salts, permanganate of potash, and calcium chloride. Unlike copper salts, both of the latter reagents are rapidly decomposed, they effect a considerable reduction in the number of bacteria present, and the resulting compounds are of harmless character from the physiological standpoint. Recent experience at Poughkeepsie relates chiefly to the employment of calcium chloride, which has been found beneficial in preparing the water for filtration The general tendency to-day in water purification is toward reduction of the work to be performed in filters. British endeavors of this class are mainly confined to the provision of storage reservoirs where partial purification occurs by natural agencies, while American engineers more generally attempt to hasten the process by means of coagulants and disinfectants alone or in combination. The papers mentioned are worthy of consideration, but we think the British method of preliminary treatment generally preferable, especially for waters already characterized by a fairly large proportion of mineral salts.

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The Russian Secret Service and Aeronautics.

The Russian government views with alarm the advent of the airship or aeroplane. Evidently the fear that some aeronautic nihilist may possibly drop a bomb upon the Czar's palace has wrought up the government to a pitch of nervous fear The Minister of the Interior has given the following instructions to his subordinates

1. All ascents of flying machines and airships are to be carefully watched by the police

2. All the aero-clubs of Russia must be registered, and their members are subject to supervision by the secret police.

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A good example of the economy often accomplished by chemical investigation and discovery is furnished in the case of ultramarine. Many years ago when this was made by powdering the mineral lapis lazuli, it sold for more than its weight in gold. Now that the chemist has discovered how to make the same material from such cheap substances as kaolin, [illegible] [illegible] and carbonate, charcoal, sulphur and [illegible], the price is only a few cents per pound.—[illegible] [illegible]

Handy Man's Workshop

A SIMPLE METHOD OF LAYING OUT A SUN DIAL.

BY E. WILLARD BROWNE.

The sun is a very poor timekeeper At this time of the year it is about a quarter of an hour fast, while in February it will be nearly fifteen minutes slow For this reason we do not take time from the real sun, but from an imaginary sun which comes to meridian every twenty-four hours exactly on the second. There are only four days in the year when the real sun is on time, viz., April 15th, June 15th, September 1st, and December 25th A sun dial records the real sun's time and not the mean sun's time, and consequently is a very poor timepiece for actual service in these days. However, it makes a very attractive ornament, and readers of Handy Man's Workshop may find it interesting to make a simple dial. It is popularly supposed that the laying out of the sun dial face is a difficult matter, but this can be done without the use of mathematics if the difference between the real solar time, the mean solar time, and standard time is clearly understood Noon, strictly speaking, is the moment when the sun comes to meridian, that is, when it is due south of the observer As we have just stated, if we depended upon the real sun to mark the noon hour, some of our days would be shorter than others. Our watches would have to run anywhere up to thirty seconds a day fast and slow at different times of the year, in order to keep pace with the real sun. The imaginary sun which keeps perfect time is not much better for general purposes because noon would be different to different observers. A man in New York would have different time from a man in Brooklyn. A commuter from the Oranges would have to set his watch ahead about a minute when going to business and back a minute when returning home. To avoid all this complication we take our time from the mean noon at certain fixed meridians just 15 degrees apart. The eastern section of the country gets its time from noon at the seventy-fifth meridian west of Greenwich, central time is taken from noon at the ninetieth meridian, mountain time, from the hundred-and fifth meridian, and Pacific time from the hundred-and-twentieth meridian west of Greenwich Bearing these facts in mind, we can proceed to lay out our dial without the use of mathematics on the four days above referred to when the real sun and the imaginary sun come to meridian at the same time.

Fig. 1.—A SUN DIAL FOR USE AT THE NORTH POLE.

First of all, it is absolutely necessary that the line casting the shadow on the dial face shall be absolutely parallel with the axis of the earth. This being the case, it makes no difference what the position or form of the surface receiving the shadow may be so long as it is rigid. Our problem resolves itself therefore into the question of how we shall provide for the placing of this shadow-casting line.

It is perfectly apparent that at the North Pole this line would occupy merely an upright position, and a dial for such a situation would be similar to Fig. 1. At the southern extremity of the earth's axis a similar instrument would be required, except that the hour marks would have to number round in the opposite direction

At the equator an apparatus similar to Fig. 2 has been devised. If the shadow-casting line is to be parallel to the earth's axis, it is evident that at this point it must be perfectly horizontal and pointing north and south. Just here it may be of interest to call attention to the fact that at the equator the sun always rises and sets at six o'clock. The most convenient surface to receive the shadow from a line placed as above described would be the interior of a half cylinder, and if this were equally distant at all points from said line, the hour marks would be twelve equal divisions of its surface. This same form of sun-dial could be used at any latitude, provided it has an arrangement for canting it up (Fig. 3) so as to maintain the position of the axis line parallel with the earth's axis.

In latitudes midway between the equator and the poles a horizontal form of sun-dial is most commonly used, and we will construct ours according to that model.

Fig. 4 affords a general idea of the method of construction. The material should be well-seasoned pine for the baseboard which may consist of two pieces of ⅞ inch stock measuring 10½ by 6 inches each with two 12-inch cleats to correspond In the preparation of the gnomon or shadow-casting piece *A B C*, the essential feature is that the angle at *B* shall invariably correspond in degree with the latitude of the locality where the dial is to be placed For instance, since Boston is 42 deg. 21 min. north latitude, angle *B*, if the dial is to be used in Boston must be a shade over 42 1/3 degrees, at New York the angle *B* should be 40 3/4 degrees.

Fig 2.—A SUN DIAL SUITABLE FOR USE AT THE EQUATOR.

The base line of the gnomon should be at least long enough to extend two-thirds of the way across the board. If our dial is to be for indoor use only the shadow piece may be constructed of heavy bookbinder's pasteboard, but for outdoor exposure it had better be made of brass or heavy galvanized sheet iron Make a paper pattern, and get your tinsmith to cut it out for you. The out-of-door sun dial should receive at least three good coats of the best white lead paint as a protection from the weather

Having reached this point and having assembled the various parts, fastening them securely in place with screws or good wire nails we are now ready to make our markings upon the dial surface for the twelve or fourteen hours of daylight during which our sunshine clock will be of service These may be made temporarily with lead pencil and afterward lined in with waterproof ink or good black paint.

It is very essential while placing these lines of course, that the dial shall remain in an absolutely fixed position and that the gnomon shall point exactly north and south, as it ought always to do if our time is to be at all accurate Now, without a surveyor's compass how shall we accomplish this? Mean solar noon in Boston is at sixteen minutes of twelve o'clock. By that we mean that at 11 44 the imaginary sun is directly in the south and if at noon on Christmas day or any other of the four days above mentioned when the imaginary and real suns coincide we place our dial so that the gnomon with angle *B* toward the south, casts at either side no shadow whatever, the shadow that extends from the edge of the gnomon marks the hour of XII At 12 44 a line drawn along the shadow will be the I o'clock mark of the real solar time. With a reliable timepiece in hand we may thus proceed to make the necessary markings as the hours go by, being careful of course to see that the position of the instrument has not been altered The morning hours will bear the same relative distances from XII on the opposite side of the dial.

Fig 3.—A CONVEX DIAL TILTED TO THE ANGLE OF ITS LATITUDE.

To find the difference between mean solar time and the standard time for any locality apply the following rule Ascertain the difference in longitude between the given place and the meridian of the standard time of that locality as indicated by the following table

Colonial time is mean solar time of 60th meridian
Eastern time is mean solar time of 75th meridian
Central time is mean solar time of 90th meridian
Mountain time is mean solar time of 105th meridian
Pacific time is mean solar time of 120th meridian

Multiply the number of degrees of difference in longitude by four and the result will be the difference of time in minutes.

If the standard meridian is the larger of the two, mean solar noon will occur just as many minutes before 12 o clock standard time If it be smaller, the time will be so many minutes later

To illustrate

The meridian of eastern time is 75 deg
Longitude of Boston is 71 ¼ deg
——
4 deg
Multiply by 4
——
16 minutes.

The meridian of eastern time being the *larger* therefore mean solar noon will occur at 16 minutes *before* 12 o clock and the sun dial must be placed so that the gnomon casts no shadow at that time

Should it be thought desirable to construct a vertical sun dial to be attached to the southern wall of a house, for instance the same principles apply as we have already laid down, only be sure to bear in mind that the essential angle of the triangular gnomon is always the one farthest to the south and not the one resting against the baseboard It is more than probable that the wall to which the dial is to be fastened does not face exactly south so that it will be necessary to bend the gnomon slightly to the east or west, in order to get the proper direction for its upper edge

Having had good success in the construction of one or more sun dials made according to the foregoing suggestions, possibly it may be thought desirable to construct something of a more permanent nature, and the following directions in regard to the use of concrete for that purpose may be of service

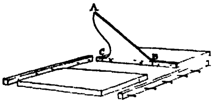

Fig 4.—CONSTRUCTION OF A HORIZONTAL DIAL.

In making a mold for the construction of the plane portion of the dial one of two methods may be followed Make a shallow box the exact size and shape of this part of the dial. Before the bottom board is fastened on, draft upon its interior surface a reversed tracing of the markings of a previously constructed dial giving of course also the hour-mark figures These may now be gone over with a V-shaped chisel if raised markings are desired or they may be built up with modeler's wax if figures indented in the stone surface are thought to be more desirable A thin but tapering piece of board should be fastened at the point where the gnomon is to be inserted later on The entire mold should now be thoroughly gone over with tallow to prevent the concrete mixture from sticking at any point

A good concrete for our purpose may be made of two parts sand and one of Portland cement These should be thoroughly mixed before water is added About 20 per cent of water is supposed to be about the right proportion to use but a better rule to follow is to continue to add water until the mixture has such a consistency that tapping upon it with a flat trowel will bring water to the surface The concrete should be allowed to set for five or six hours before the mold boards are removed and by the way these should have been fastened together with screws After this the stone should be kept moistened every hour or two for two or three days to obtain the best results Another method of making this part of the dial though the result might not be quite satisfactory would be to fill a shallow box with concrete working the markings into the surface before it has begun to set very much

The gnomon may be made of iron by your blacksmith neighbor in which case it ought to undergo some treatment to prevent its rusting or it may be cast of brass from a wooden model Having this firmly cemented in the groove provided for it we have now a dial ready for whatever surroundings may seem desirable Concrete stone may be rendered impervious to the action of water or frost by the following treatment First wash it thoroughly with a hot solu tion of Castile soap, and after rubbing in and drying, apply a solution of alum.

Since the color of the concrete may not be wholly satisfactory for receiving the shadow of the sun, the upper surface of our stone may be kept painted with lead paint or with an insoluble whitewash

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EXPERIMENTAL COLOR MAKING WITH SIMPLE CHEMICAL SOLUTIONS.

BY A J JARMAN

Color manufacturing to-day is carried out upon a very large scale, and so cheaply that it has often been considered quite impracticable for the amateur to prepare his own colors but one should bear in mind that the colors so produced are of absolute purity containing no adulteration whatever Furthermore, there is not only an elementary knowledge of chemistry obtained but a useful and valuable product, at the cost of a very small outlay

The following colors can be easily made without the use of special chemical vessels the one essential point being that all the water used should be filtered so as to free it from organic matter and mechanical impurities in the form of iron rust and sometimes small fragments of carbonate of lead obtained from the lead supply piping

The following solutions must be made in clean glass bottles, half a dozen strips of glass half an inch wide and ten inches long and half a dozen or more of common glass tumblers and a few sheets of white blotting paper

In the clean bottles make up the following chemical solutions

1 Iodide of potassium 120 grains dissolved in 10 ounces of water a label being placed thereon with the name of the chemical

2 Bichloride of mercury, 120 grains dissolved in 10 ounces of hot water and allowed to become cold

3 Two drachms of nitrate or acetate of lead dissolved in 10 ounces of hot water

4 Half an ounce of protosulphate of iron dissolved in 10 ounces of water

5 Half an ounce of ferricyanide of potassium (*red prussiate of potash*), also dissolved in 10 ounces of water

6 Half an ounce of bicarbonate of soda dissolved in 10 ounces of water

7 Two drachms of nitrate of silver dissolved in 10 ounces of distilled water

8 Half an ounce of bichromate of potash dissolved in 10 ounces of water

Now having all these chemical solutions made proceed as follows Pour into one of the tumblers two or three ounces of the bichloride of mercury solution, then add carefully half an ounce of the iodide of potassium solution, stir well with one of the glass strips when instantly a beautiful deposit of scarlet vermilion will be formed

Be careful not to add too much iodide solution because this scarlet vermilion is soluble in a solution of iodide of potassium which may become partially or wholly re-dissolved If this is the case continue to add more of the bichloride of mercury solution when the precipitate will return Always have the mercury solution in *excess* this will do no harm The precipitate or scarlet vermilion, is known chemically as *iodide of mercury*

The iodine, which was chemically bound up with potassium was freed when the iodide solution was mixed with the bichloride of mercury solution there being a greater affinity between the iodine and mercury than between iodine and potassium hence the change. So iodide of potassium and bichloride of mercury when brought together in solution form *iodide of mercury* and chloride of potassium

To purify the color so produced all that is necessary is to allow the precipitate to subside pour off the clear portion (this contains the chloride of potassium which is held in solution) pour upon the precipitate some clean water Allow it to subside About four such washings will remove the impurity Then fold a piece of white blotting paper about ten inches square so as to form a quarter of the sheet Open the fold, pour into it the wet precipitate wash out the tumbler pour the washings into the blotting filter and place the blotting filter into another tumbler or into the same one, if more convenient When the precipitate has become well drained it may be allowed to dry or be used in a moist condition by adding a few drops of gum arabic mucilage being well incorporated with a bone or hard rubber paper knife upon a piece of ground glass, or when dry ground with a pestle in a small mortar, and used as desired The above description of filtering will apply to *all* the following colors.

Pale lemon yellow is made by pouring two or three ounces of the lead solution into a clean tumbler and adding half an ounce of the iodide of potassium solution Stir the mixture well the pale yellow precipitate being *iodide of lead* Wash the precipitate and filter as for the vermilion

Lemon chrome is made by the following mixture Three ounces of lead solution is poured into a tumbler, and two ounces of the bichromate of potash solution poured into it. Stir with a clean glass strip The beautiful rich yellow precipitate is chromate of lead

The chromic acid of the bichromate of potash has combined with the lead of the lead salt (owing to the greater affinity of these two bodies), so that chromate of lead is formed, and acetate or nitrate of potash is formed as the result of chemical combination. Wash the precipitate and filter as before, *always* using a fresh filter paper for each precipitate Pure white or carbonate of lead is made as follows Pour two ounces of the lead solution into a tumbler add about one ounce of the bicarbonate of soda solution a dense white precipitate of pure *carbonate of lead* is formed (white lead), the precipitate being washed and filtered as before In this case the carbonic acid, from the bicarbonate of soda has attacked the lead from the acetate of lead solution, carbonate of lead being formed and acetate of soda.

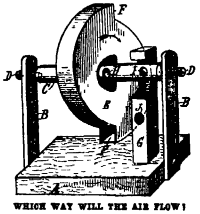
Prussian blue is formed by the following mixture Take three ounces of the red prussiate of potash solution in a clean tumbler pour into this about three ounces of the protosulphate of iron solution, instantly a dense beautiful rich blue precipitate is produced stir this well, the resulting precipitate is Prussian blue In this case the cyanogen that was combined in the red prussiate of potash has seized the iron of the protosulphate and formed *cyanide of iron*, while in the clear solution, when the precipitate subsides is held the sulphate of potash formed by the reaction This precipitate will take some time to subside Never mind this wash this precipitate as before when it will be found that there is one of the finest blue colors produced that it is possible to obtain A beautiful rich brick red is made by pouring into a tumbler four ounces of the nitrate of silver solution, then add thereto three ounces and a half of the bichromate solution, stir this well with a glass strip stir it vigorously because the precipitate is apt to be rather coarse if stirring is not well attended to This precipitate is chromate of silver a very permanent color Although the term brick red is given to it it is more of a purple red a color in fact that cannot be produced by any other means By preparing the above colors one's self there is not only great pleasure derived but a knowledge that can only be obtained by experiment.

◆

AN INTERESTING PARADOX

BY O H. BOURNE

In the demonstration of truths of a scientific character, it is sometimes surprising to an experimenter to obtain results seemingly opposed to what we conceive to be a natural sequence of means employed Thinking it may interest some of the readers of the SCIENTIFIC AMERICAN I give the details of a small apparatus which I constructed some time ago As shown in the accompanying engraving the device comprises a baseboard *A* from which rise two supports *B B* A hollow shaft *C* is supported at each end by means of screws *D*, threaded through the vertical supports Mounted on the shaft *C* is a hollow drum *E*, consisting of two semi-cylindrical portions eccentrically connected to form the offsets *F* at opposite sides of the drum These offset portions are open, and provide communication with the interior of the drum Close to one of the supports *B* is a box or air chamber *G*, through which the shaft *C* runs The shaft *C* is provided with an aperture *H* communicating with the interior of the drum, and an aperture *I*, communicating with the interior of the air chamber *G* An opening *J* provides communication with the outside air I have asked a number of persons to predict the result of rapidly rotating the drum in the direction of the arrow (which was done in this case by drawing a cord wound on the shaft), and all have stated their belief to be that the air would be drawn into the drum and would pass through the shaft into the air chamber issuing from the aperture *J* In fact, the result is a current in the opposite direction, as can readily be demonstrated by holding a piece of paper before the opening *J* The paper will be sucked inward. The explanation, of course, is that the centrifugal force of the air in the drum more than balances the exhausting power before the apertures *F F*.



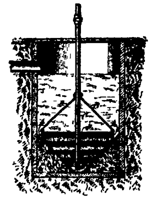
WHICH WAY WILL THE AIR FLOW?

◆

FILTER FOR CISTERNS.

BY CHARLES [illegible].

The accompanying illustration pictures a method of filtering the water in a cistern so as to make it fit for drinking This filter may be applied to any cistern by simply filling the cistern with stone or concrete in such a manner as to get an inverted conical or pyramidal bottom The device comprises a basket *A*, adapted to fit into this conical bottom The basket is preferably made of sheet iron or steel of light gage, and to prevent it from rusting should be galvanized. The basket should be attached by means of straps *B* to the pump pipe *C* A wire screen *E* fits across the bottom of the basket, and is secured to the pipe *C* just above the perforated bottom section of the pipe This forms a small chamber *D* in which the filtered water collects. Above the screen *E* are placed layers of filtering material, consisting first of coarse gravel over which is laid fine gravel and then a layer of fine sharp sand Above this a layer of charcoal should be placed, then a layer of fine sand a layer of coarse sand a layer of fine gravel, and finally a layer of coarse gravel Over this is placed a coarse wire screen or perforated plate to keep the mass in place



A CISTERN FILTER.

The idea of this arrangement is to do away with any contamination of the water by filtering it only as it is used The wide top of the filtering basket provides a large filtering area while the apex allows as small a volume as possible to stand in the filter basket and become brackish in case of a long drought This small amount may be thrown away if it is found unfit for use and fresh filtered water quickly obtained, at the same time keeping as large a reserve above the filter basket as the size of the cistern will permit.

◆

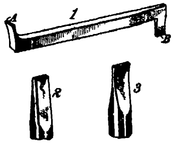
A CLOSE-CORNER SCREW DRIVER.

BY HERBERT S. DAVIS.

The screw driver here illustrated will be a welcome addition to anyone's kit of tools, as sometimes in a close space one cannot turn a regular screw driver with any degree of satisfaction whereas with this screw driver by using first one end and then the other the screw can be tightened up nicely

In use it somewhat resembles an angle wrench Take a piece of ¼ inch square tool steel, about 4½ inches long and heating it to a fair heat bend one end over and form a lip as shown at *A*, Fig 1 Then, turning it one-quarter way round (this is done so that the other end clears the work when using) bend the other end and shape it as at *B* Dress up the blades with a file making them slightly hollow back of the edge of the lip which should be a good 1/64 or 1/32 inch thick Then harden it at as low a heat as possible, and temper to a strong blue

One need not confine himself to this size of steel. The device can be made lighter or heavier to suit various requirements.



CLOSE-CORNER SCREW DRIVER.

Right here a word on the shape of a screw-driver blade may not be amiss. Most of the screw drivers the writer has seen have lips of wedge shape as shown in Fig. 2 When made like this they have a tendency, when in use, to climb out of the slot and damage it so that it is difficult to tighten or loosen the screw.

The blade should be made as in Fig. 3, slightly hollow back of the lip. When made this way it will catch in the bottom of the slot and will not ride out.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

FORM-GAGE.—[illegible], Chicago, Ill. In this patent the invention has for its purpose the provision of a gage suitable to obtain the shape and measure of different sized and proportioned women, for the construction of bust forms and stands upon which to drape their clothing.

ATTACHMENT FOR WEARING-APPAREL.—A. GOLDMANN, New York, N. Y. By means of this attachment the waist dimensions of garments can be altered to adapt them for use by persons having different waist measurements, it obviates the use of a draw string; requires no alteration in the garment to permit its use in connection therewith, and is inexpensive to manufacture.

GARMENT RACK.—B. HASSKOWITCH, New York, N. Y. This rack supports a plurality of garments. Two members are employed, one of which is normally fixed and the other which is normally movable and these members are so connected together that the movable member may be pulled out longitudinally together with the garments supported thereby and may then be rotated to better display the garments.

HAT-GUARD.—C. H. SHAW, New York, N. Y. This invention is an improvement in hat guards, and the inventor has in view such a device in which the guard string will be automatically drawn within the hat when released and the effective length of the string altered to suit the convenience of the wearer.

Electrical Devices.

ELECTRIC DETONATOR.—G. A. ALLEN, Western Springs, Ill. More particularly the invention relates to detonators of the type operated by aid of electricity, the more particular purpose being to guard the explosive materials and exclude the entrance of moisture, so as to preserve in good condition the priming and other explosive substances contained within the detonator shell.

Of Interest to Farmers.

INCUBATOR.—E. A. MAISCH, Anderson, Cal. In this electrically heated incubator the invention relates more particularly to the construction of the heating coils and the egg supporting trays. Means provide for an even temperature at all parts of both trays, only a small quantity of current is consumed and the contrivance requires only a simple method of regulation.

BEET DIGGER AND TOPPER.—W. C. MAURE, Greeley, Colo. This improvement is in beet diggers and toppers, and the device is especially adapted for digging and topping sugar beets, which are generally planted in elevated ridges and at spaced distances apart. Beets below a certain size are culled or rejected and the remainder must be topped at the crown.

Of General Interest.

EXERCISING APPARATUS.—W. P. STULL, McKeesport, Pa. In using the apparatus it is clasped in the hand with the thumb on one grip and the fingers on the other and the hand is opened and closed with the arms pendent, extended and bent to the shoulder or with any other movement of the arms, advisable or desirable. At the same time the body may be bent into various positions.

ADVERTISING DEVICE.—J. E. DOWSING, New York, N. Y. In this instance the invention has reference to advertising devices admitting of general use and more particularly to a type of advertising device suitable for campaign purposes with a view of attracting the attention of the public to a particular candidate.

DOOR HANGER.—F. J. S. MIELY, Gunnison, Colo. This invention relates to door hangers and especially to such as are employed for hanging sliding doors such as car doors, barn doors and the like. The object is to provide a track of improved form which will be reliable in operation, and further, to provide improved means for supporting the track.

Hardware.

STRAINER.—T. RICHARDSON, New Orleans, La. This device is for application to faucets for straining water and other liquids and thereby removing wigglers, bugs and other solid particles. The object of the invention is to provide in such a device a detachable straining element, which is easily applied and displaced for cleansing and other purposes without removing the device from the faucet.

NUT-LOCK.—T. HAND, Walla Walla, Wash. This form of nut lock is much stronger, more rapidly applied and removed and may be manufactured at much less cost on account of its simplicity, there are no key holes or cavities to become clogged, it automatically adjusts itself to a constantly tightening position and may be removed by simply exerting a holding strain on a lug by a crow-bar, pick, or other tool, if the wrench should not be available.

MITER-BOX.—W. E. [illegible], [illegible] Center, N. Y. This inventor provides a box wherein the saw is guided to operate at a variety of angles from the perpendicular, while operating at various angles on horizontal planes. The operative positions may be readily and quickly adjusted, and means provide for regulating the depth or extent of cutting of the blade.

Heating and Lighting.

BOILER-TUBE CLEANER.—J. D. THOMPSON, Eureka, Cal. The object here is to provide a cleaner for tubes, which is adapted for directing a jet of steam through the boiler tubes from their rear, it being possible to use the cleaner without dismantling the boiler or furnace in any manner and without drawing the fire from the furnace.

ELECTRICALLY OPERATED WATER HEATER.—J. A. HUNNEWELL, Lowell, Mass. The more particular purpose of the inventor is to provide a type of heater containing a minimum of parts, *the latter being so arranged* that water passes through a long tube containing a heating coil, the cold water entering at one end of this tube and the hot water being drawn from the opposite end of the same.

VACUUM AIR VALVE.—C. A. DUNHAM, Marshalltown, Iowa. This invention pertains to certain improvements in vacuum air valves intended for use in connection with vacuo vapor heating systems, or for any class of heating work in which it is desired to vent air from the mains, returns, or other portion of the system in which low pressure steam is used.

Household Utilities.

WINDOW SHADE SUPPORT.—C. C. BROWN, Revelstoke, British Columbia, Canada. The object of this invention is to provide a new and improved window shade support arranged for convenient up and down adjustment on the window to allow moving the shade roller to any desired height and to permit convenient manipulation of the window shade.

FLUSH TANK.—B. WALKER, JR., Austin, Texas. The improvement refers to flush tanks, and the aim is to produce a tank having a valve of simple construction which will operate to close automatically after the water of the tank has run off. A further object is to provide an improved construction for controlling the main lever of the tank which operates the flush valve.

FOLDING CRIB OR BED.—E. GUNDELACH, New Rochelle, N. Y. The intention in this case is to provide a crib or bed which is simple and durable in construction, exceedingly strong and cheap to manufacture and arranged to permit of conveniently folding it into a comparatively small bundle for transportation or storing purposes.

JAR OPENER.—J. H. SMITH, Rochester, N. Y. The object of the invention is to provide an opener for jars containing fruit, vegetables and other food stuffs, and arranged for convenient application to pry the closure open, with a view to break the vacuum in the jar and the adhesiveness of the closure to the jar thus permitting convenient removal of the closure.

Machines and Mechanical Devices.

REINFORCEMENT FOR BOOK LEAVES.—F. H. CARMI, Los Angeles, Cal. The main purpose here is to strengthen the binding edges of loose sheets to such an extent that the sheets may be moved upon the posts or other binding mechanism without mutilation. Another purpose is to provide a binding edge which will be of the same thickness after reinforcement has been applied, as the main body of the sheet.

SPEEDOMETER.—E. SCHNEIDER, XV Staglgasse 8, Vienna, Austria. The speedometer according to this invention is connected to an ordinary clock work which couples a spindle to an indicator device intermittently for a definite period of time so that the index of the indicator is set in accordance with the speed of the spindle at the time.

COIN-SORTER.—T. F. GALLIGAN, Providence, R. I. This apparatus is for use in automatically separating coins according to their several denominations. It has coin delivery openings successively decreasing in size from the top to the bottom passage, according to the size of the coins, a coin carrier in each passage, means for sweeping the coins into the pockets of each carrier and means for revolving the carriers to finally carry those coins remaining in the pockets over the several denomination outlets whereby the coins drop through by gravity.

SAUSAGE TWISTING AND LINKING MACHINE.—W. J. COLLINS, New York, N. Y. An object in this case is to provide a simple and efficient machine which can be driven from any suitable source of power and which forms sausage links of uniform length. The links may be also formed of different lengths without danger of tearing or injuring the same, and the machine twists the casing so tightly that it cannot subsequently untwist.

TRIGGER MECHANISM.—E. R. WILLIAMS, St. Joseph, Mo. The purpose of the inventor is to provide a mechanism provided with a very sensitive auxiliary trigger on the usual or main trigger to securely lock the main trigger and hammer in firing position, and to permit an easy and quick release of the hammer for firing purposes.

Prime Movers and Their Accessories.

COMBINED TIMER AND DISTRIBUTER.—G. T. BROWN, New York, N. Y. This invention is for use in connection with multi-cylinder internal combustion engines for controlling the passage of the spark at the igniter. The casing is supported rigidly so that there can be no movement whatsoever, and upon the central shaft the inventor provides a helical contact member movable longitudinally of the shaft and rotatable therewith. The pitch of the helix and position of the helical member on the shaft determine the time of closing of the electric current.

STARTING CRANK FOR INTERNAL-COMBUSTION ENGINES.—J. A. LAWSON, New York, N. Y. This invention pertains to improvements in cranks for internal combustion engines and more particularly to an improved means whereby the crank may be locked to the shaft by the mere act of grasping the handle of the crank, and whereby the releasing of the handle will release the grip of the crank upon the shaft.

COMBINED TURBINE, MUFFLER AND FLY WHEEL.—J. A. LAWSON, New York, N. Y. Mr. Lawson not only utilizes the pressure of the gas but he prevents the high temperature of the gas from injuring the wheel rotated thereby. This wheel is so constructed as to operate as a fly wheel and furthermore he utilizes the wheel in creating a partial vacuum at the exhaust valve or valves of the engine during the cranking or starting of the engine.

Pertaining to Vehicles.

HANDLE BAR FOR BICYCLES.—J. R. LOGAN, Fresno, Cal. The intention in this case is to provide a bar for bicycles which serves as a receptacle in which the hose employed in connection with a pump for inflating the tires may be stored. By stowing the hose it is always at hand ready for use and by utilizing the bar a receptacle is provided which is not in the way and adds but little cost to the handle bar.

WEAR STRIP FOR CART AND WAGON BODIES.—J. T. HAMILTON, Council Bluffs, Ia. The invention relates to vehicles used for carrying grain and similar material which may leak out at the rear of the vehicle body. The invention strengthens the parts at this point, renders them more durable and operates positively as a preventive of the waste of grain by leakage.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions, books, etc. This will facilitate answering your questions. *Be sure and give full name and address on every sheet.*

Full hints to correspondents were printed at the head of this column in the issue of March 14th or will be sent by mail on request.

(12129) F. A. McD. says: There has recently been brought out an electrolytic alternating current rectifier consisting mainly, I understand, of aluminium electrodes immersed in a solution of aluminium chloride. If you have ever published any account of the construction of this apparatus or know of any such description having been published I would be pleased to have you advise where I may find the same. A. You will find the electrolytic rectifier described with plans for its construction in SUPPLEMENT Nos. 1478, 1644, 1671 and *in the* SCIENTIFIC AMERICAN Vol. 97 No. 8 and Vol. 101 No. 7. We send these papers for ten cents each.

(12130) C. C. says: I have quite a lot of dry batteries. They have gone dead. Is there any way they could be charged or worked over to put some life into them? A. Nothing can be done for dead dry cells to revive them as good as new. Sometimes holes are punched in them and they are put into jars as wet cells getting some current out of them. Sometimes the top is cut out and fresh solution of sal ammoniac is put in. The strength and life of the renewed cell are not enough to pay for the labor and cost.

(12131) J. R. says: Will you kindly *tell me how much per horse-power is the selling* price of electricity when it is generated and sold to consumers? I ask this question for the purpose of framing a lease for a water power which we are trying to have improved. A. The price of electricity in this city is 10 cents per kilowatt hour either for power or lighting purposes. The kilowatt is the more usual unit of measurement because it may be more conveniently estimated simply by multiplying the voltage of the current by the amperage, e. g., 10 amperes of 250 volt current gives 2,500 watts or 2½ kilowatts. 746 watts or ¾ of a kilowatt nearly are equivalent to one horse power or one kilowatt = 1 1/3 horse power. The price varies in different parts of the country being higher at remote coal burning plants where fuel is expensive and lower at hydro-electric generating stations where power costs nothing. The highest price we know is 22 cents per kilowatt hour and the lowest 5 cents, the New York price above quoted being about the average and a fair price to estimate upon.

(12132) C. R. says: Allowing that a man weighing 300 pounds and 3 ounces weighed 300 pounds by spring balance—3 ounces being lost in centrifugal force at sea level equator—what would he weigh at the North Pole, with 13 miles less of earth under him? I say .05 pounds as there is less matter to attract. What would he weigh at the top of a mountain 5 miles high, equator? Would he weigh less than 300 lb. or over the deepest (5 miles) ocean equator? That is, does the water attract as vigorously as earthy matter? Will the SCIENTIFIC AMERICAN get a sea captain to try a common ball with spring balance at sea level New York and then over the deepest ocean abyss? A. The weight of a person at different places on the earth is calculated by the application of Newton's law of gravity. The weight is directly proportional to the attracting mass and inversely proportional to the squares of the distances between the centers of gravity. The results obtained show that a body will weigh about 1/190 part *more* at the poles than at the equator. (See Young's General Astronomy, Chapter V, The Earth as a Globe. We can send the book for $3, postpaid.) The centrifugal force at the equator is 1/289. Hence a man or other body really weighing 300 pounds would seem to weight a trifle less than 299 pounds at the equator because of centrifugal force. The loss given by you as 3 ounces is too small. At the poles a man whose real weight is 300 pounds at the equator would weigh 301.5 pounds. The earth's mean diameter may be taken as 7,917.6 miles as given by Young in his latest book. The oblateness of the earth is usually taken as 26 miles. From these figures you will see that the equatorial radius is 3965.1 miles and the polar radius is 3952.1 miles. You may disregard the fraction and use only the whole numbers. At the pole there is a little less matter to attract a body and for this reason it would weigh a little less but at the same time it is brought nearer the center of the attracting body. It is 3952/3965 as far from the center and hence the attraction $(3965/3952)^2$ times as great and the weight is increased to the same degree. The weight on the top of a mountain 5 miles high at the equator would be $(3965/3970)^2$ times the weight at the sea level. We do not know what change of weight there would be over the deepest ocean. Pendulum experiments to determine this are not easy on a ship nor is accurate weighing very easy on shipboard, certainly not the accurate weighing of a large weight. Balances for weighing heavy articles are not sensitive enough to determine the weight to a small fraction of a unit. We may say that the water attracts less than the rocks of the earth since it is less dense than the rocks. We must leave you with these explanations to figure out the results since we do not solve problems for correspondents as you will see by referring to our Hints to Correspondents.

(12133) *H. L. T.* says: Some years ago I heard of an instrument used by architects to determine the extent of the sun's shadow for any given condition at any particular season of the year. Could you inform me who manufactures or sells this instrument? I have made inquiries from a number of the prominent supply houses without success. A. We do not know any instrument especially for determining the sun's shadow. This can be drawn by a protractor when the altitude of the sun above the horizon has been determined. To find the altitude of the sun for any day at noon when the shadows are shortest since the sun is highest, you should have the latitude of the place and the declination of the sun. Subtract the latitude of the place from 90 deg. To the remainder add the declination from March 21st to September 21st. From the remainder subtract the declination from September 21st to March 21st. This gives the angle of altitude of the sun at noon above the southern horizon. With this angle the shadow cast by any object can easily be drawn.

(12134) [illegible] Electric Company says: Can you favor us with receipt or formula for the silvering of lens mirrors such as are used for marine searchlights or projectors? A. You will find in our SUPPLEMENT No. [illegible], price ten cents, full and accurate directions for silvering glass for mirrors. The method is the one now in general use by precipitating silver upon the glass from a solution. With cleanliness and care good results are not difficult to obtain.

(12135) J. D. asks: Are you aware of any plan being discovered how the pyramids of Egypt were built? A. We believe that authorities upon Egyptian antiquities are agreed as to the probable method of handling the stones of the pyramids and the much larger statues and obelisks which were moved hundreds of miles and set up in place. Man power alone can have done the work and it does not seem necessary to suppose any unknown modes were used for doing the work. With men enough all can be accounted for. Frescoes exhibit such work going on. Some have thought that earth was filled in to form an inclined plane as the pyramid was raised to the higher portions and the stones were then slid up this plane which was removed after the building was completed. In modern times such stones have been moved long distances by man power. The base of the statue of Peter the Great in St. Petersburg was dragged from Finland to its present location by men. Its weight is estimated at 2,000 tons. Iron rails were laid upon which cannon balls rolled, and thus the huge block was drawn by men.

NEW BOOKS, ETC.

Kriechtiere und Lurche Deutschlands. By Dr Kurt Floericke. Kosmos Gesellschaft der Naturfreunde. Geschäftsstelle Franckh'sche Verlagshandlung in Stuttgart. Price, 50 cents.

In this book Dr Floericke has presented a popular account of the principal reptiles and amphibians of Middle Europe. To those who are familiar with the German language and desire to obtain a general knowledge of an interesting class of animals without delving into technical details, the book can be recommended.

The Fixed Law of Patents. By William Macomber. Boston: Little, Brown & Co. 1909. Large 8vo., pp 1,060. Price $7.50 net.

In this work Mr Macomber has presented in digested form the patent statutes, the decisions of the Supreme Court of the United States and the decisions of the nine Circuit Courts of Appeals the three constituting what Mr Macomber calls The Fixed Law of Patents. As a piece of compilation and arrangement the book is indeed admirable, as a reference work for the patent lawyer it will be extremely helpful. The principles of patent law although fairly few in number and simple in essence, have in later years become more or less befogged in the effort of non-technical judges to administer the patent law fairly. In view of that fact any attempt to bring something like order out of a chaos of decisions is certainly commendable. Because the book gathers up the appellate law, in the language of decisions it should be of interest to the specialist. Unless he has digested the law for himself the specialist will hardly have such a compilation. Considered as a whole the work may be regarded as an orderly statement of the courts language in important cases, and therefore absolutely authoritative.

Inns and Taverns of Old London. By Henry C Shelley. Boston: L. C. Page & Co. 1909. 364 pp. Price, $3.

The subject of inns and taverns in London has always been a fascinating one, and the literature concerning them is quite voluminous. The present volume sets forth the historical and literary associations of those haunts together with an account of the most notable coffee houses clubs and pleasure gardens of the British metropolis. The English have always had a reputation of being essentially a home loving people, still in the seventeenth and eighteenth centuries they seem to have exercised considerable zeal in creating substitutes for that home which they ought to have loved above all else. When the Londoner had procured his taverns and inns he set to work evolving a new species of public resort in the coffee house. That type of establishment appears to have been responsible for the development of the club as the substitute for the home, and then came the age of the pleasure garden. Both of the latter survive the one in the form of a more rigid exclusiveness than the eighteenth century Londoner would have dreamed possible the other is so changed that frequenters of the latter would scarcely recognize the relationship. The engravings are taken from old prints, and are of great interest. The book is beautifully printed and most attractively bound.

Imagination in Business. By Lorin F Deland. New York: Harper Brothers, 1909. 18mo., 108 pp. Price, 50 cents net.

This little book contains a number of shrewd essays which deal with a curious phase of business. It shows the remarkable part which imagination plays in business especially to-day.

Light and Heavy Timber Framing Made Easy. By Fred T Hodgson. Chicago: Fred J Drake & Co. 1909. 12mo., 395 pp. Price $1.

The present work is a copious treatise on the modern practical methods of executing all kinds of timber framing from the simple scantling shed or lean-to to the heavy and complicated timber bridges centers, needling, and shoring roughing and railway work, tank frames and taper structures and is illustrated by 450 engravings and diagrams.

The Romance of Modern Manufacture. By Charles R Gibson. Philadelphia: J B Lippincott & Co., 1910. 12mo., 320 pp. Price $1.50.

In the present volume the author has endeavored to trace the evolution of the different industries and to describe in every day language the methods of modern manufacture in all of the principal industries. It deals with textile machinery laundry machinery, needle machinery thread machinery shoe machinery manufacture of pottery by machinery paper making manufacture of books, artificial light manufacture of confectionery the mechanical baker clocks and watches manufacture of iron making steel rails the railroad and the locomotive building a ship, and other chapters. The illustrations and diagrams are particularly clear and we are glad to note a number of the best ones have appeared first in the Scientific American and that they are repeated properly credited.

Machine Drawing and Design for Beginners. By Henry J Spooner, C.E. New York and London: Longmans, Green & Co., 1908. 8vo., 266 pp., 742 illustrations. Price, $1.25.

The author is director and professor of mechanical and civil engineering in the Polytechnic School of Engineering in London, and is the author of valuable works on drawing and machine design. The work is an excellent one and the drawings which are reproduced are thoroughly common sense. Of course, English practice is slightly different from American but the differences are not so great as to militate against the value of this book. The questions suitable for examination and home work are valuable, but the Board of Education examination papers are worthless for American students.

An Experimental Study of Bagasse and Bagasse Furnaces. By E. W Kerr, M.E., assisted by E. M. Percy, B.S. Baton Rouge, 1909. 8vo., 106 pp.

During the last few years the writer, who has charge of the instruction of students in the engineering branches of the Audubon Sugar School, has visited a large number of sugar factories in Louisiana for the purpose of gathering data and information for class room use. In these visits he has been particularly struck with the lack of uniformity in the methods employed for utilizing bagasse as a fuel, both as to the form and proportions as well as to the manipulation of the furnaces. With a view to standardizing as far as possible the methods employed, it was decided to conduct a series of investigations, the object of which should be to gain a thorough insight by general observation and by tests into the methods used in Louisiana for utilizing the heat from bagasse. The result of the labors of the author is included in the present pamphlet which gives his views on the subject most exhaustively and reflects great credit upon the author.

Laboratory Notes on Iron and Steel Analyses. By Walter Macfarlane. London and New York: Longmans, Green & Co., 1909. 12mo. 462 pp. Price, $2.50 net.

These notes were in the first instance written for the guidance of the staff in an iron and steel works laboratory which was for some years under the supervision of the author and where the results of over 40,000 estimations were annually placed on record. The methods required to be reliable and rapid, so as to control and keep pace with the manufacturing operations. It was necessary that all the analysts should work on identical lines, and the accuracy of the methods were tested in daily practice and confirmed by other analysts. These notes have been explained and published and are for the benefit of all students. The general aim of the book has been to set out a full course of assaying or analysis in full detail. The work is an excellent one and is certain of a considerable sale.

Modern Practice in Mining. Volume II. The Sinking of Shafts. By R. A. S. Redmayne. New York and London: Longmans, Green & Co., 1909. 8vo., 275 pp. Price $2.25 net.

The sinking of shafts for the purpose of opening out and developing mineral wealth constitutes one of the most important branches of mining and although a vast amount of information respecting such operations is disseminated throughout the proceedings of the various mining institutions and excellent chapters are devoted to the subject in many text books on mining so far as the present writer knows shaft sinking has not hitherto been treated from the British standpoint of the work. While the practice described is British practice it cannot help but be of interest to the mining engineers in this country. The illustrations are numerous and are well executed on a good scale.

Areika. By D. Randall MacIver and C. Leonard Woolley. With a chapter on Meroitic Inscriptions by F. Ll. Griffith. Oxford: The University Press, 1909. 4to., 56 pp., 42 plates.

This volume is the first of a series which will record the results of explorations in Egypt planned and financed by Mr Eckley B Coxe, Jr, of Philadelphia, and this is the first volume of the series to be known as the Eckley B Coxe, Jr, Expedition to Nubia. The expedition is to be conducted for five years on behalf of the University of Pennsylvania and the antiquities that may be obtained will be presented to the University Museum. The district selected for the researches is a part of the country which lies between the First and Second Cataracts, and this first volume records the results obtained in the year 1907. The plates are beautifully executed, and the monograph is an important contribution to the archæology of a section of the world concerning which very little is known.

The Autobiography of Sir Henry Morton Stanley, K.C.B. By his Wife Dorothy Stanley. Cambridge, Mass., and New York: Houghton, Mifflin & Co., 1909. 8vo., 550 pp. Price $5 net.

Stanley was a remarkable man, and this revelation of his personal life and of his keen and unprejudiced view of men and affairs stands as one of the books of [illegible] importance in this field. Of all the interesting and important autobiographies that have seen the light in the last decade none perhaps has a wider appeal to all classes of readers than the autobiography of Henry Morton Stanley. The grim workhouse, the squalid life in Liverpool, the terrible experiences at sea, his adoption by a New Orleans merchant, his life as a planter, the enlistment in the Confederate army, the wonderful picture of Shiloh, his life in prison and escape, his finding of Livingstone, the exploration of the Dark Continent, the founding of the Congo State and his closing years are described with a vigor of style which has rarely been surpassed. The book is beautifully printed and illustrated, and is certain to have a large sale, as it appeals to almost everyone.

Mechanical Drawing for Trade Schools. By Charles C Leeds. New York: D. Van Nostrand Company, 1909. Oblong 4to., 58 plates and text. Price, $2.

This work on mechanical drawing has been prepared with a purpose in view of thoroughly grounding draftsmen and others of the various machinery trades in the principles of mechanical drawing. It is also intended to familiarize them with modern drafting room practice. The author does not believe in using models, as he thinks this tends to develop copyists, and in this he is undoubtedly correct. The author who is connected with the Carnegie Technical Schools, finds that the results obtained by this system are excellent. The plates are on an enlarged scale and the drawings from which they are made are well executed. There is a bill of material with nearly every plate.

Irrigation Engineering. By Herbert M. Wilson, C.E. New York: John Wiley & Sons, 1909. 8vo., 625 pp. Price, $4 net.

The Reclamation Service of the United States now has 21 projects which have reached such a state of completion that water is being furnished settlers for irrigation of their lands. At this date 675,514 acres are under irrigation from Reclamation projects and $42,932,787 have been expended upon the construction of works completed or in progress. The revenues collected to date from projects in operation and available under the law for re-expenditure on future construction amount to $1,070,506. The present or sixth edition has been almost entirely rewritten bringing up to date the tremendous progress made in construction by the Reclamation Service. Since the last edition important changes have been produced in the design and in the materials used in structures on irrigation works as a result of the very general adoption of reinforced concrete for such works.

Architectural Perspective. By I. P. Hicks. New York: Industrial Publication Company, 1909. Square 12mo., 38 pp. Price, 50 cents.

Building Plans and How to Draw Them. By I. P. Hicks. New York: Industrial Publication Company, 1909. Square 8vo., 73 pp. Price, 50 cents.

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MAKING ALCOHOL FROM WOOD WASTE.

(*Continued from page 352.*)

gallon of alcohol, and the process costs another 6 cents, the actual cost of production being therefore about 32 cents.

The Standard Alcohol Company, owners of Messrs. Ewen and Tomlinson's patents, produces a gallon of equally pure alcohol from 5 7 cubic feet of sawdust, hitherto considered valueless, but costing if bought for manufacturing purposes, at the outside 26 cents a ton The cost of conversion and distillation is about 4 cents a gallon and the total cost of materials, process, barrels, etc, does not exceed 10 cents a gallon.

The comparative cost of producing denatured alcohol is still more in the Standard Company's favor

Wood and other vegetable fibers as is generally known, contain a large proportion of starchy matter, which can be converted into sugar by treatment with acids. This process goes on constantly in the human body the stomach being unable to digest starch but using its nutritive constituents when converted by the digestive juices into sugar

The same change must be brought about in the wood waste before fermentation for the generation of alcohol is possible.

For this purpose the wood waste in the Standard Company's process is introduced into the cylindrical 'digester' shown in our illustration the door closed, and a mixture of steam and sulphurous acid introduced by an internal spray pipe while the machine is revolved The acid acts on the starch in the wood, and at the same time the heat volatilizes the turpentine and other resinous matter in the woods used The digester is lined with a special kind of brick to resist acid.

Upon completion of the digestion the steam and gases are exhausted under water, which absorbs the surplus acid and liquefies the turpentine

The treated material is then removed from the digester, and carried by conveyers to the diffusion batteries, upon the screens of which it is deposited There it is washed by clean water, which passes through all the cells in series becoming a stronger and stronger sugar solution The cells are so arranged that each is filled in turn and each in turn, when it has been washed longest receives the fresh water after which it is emptied of the washed residues. The liquor is next neutralized with lime, any acidity preventing fermentation, pumped into a tank and allowed to settle, the clear liquid being then pumped to the distillery fermenting tanks A special yeast, similar to brewers yeast, is added, and fermentation begins from this point, the process being no different to that of making grain alcohol

Every kind and form of wood has been used, but always with the same results, a purer alcohol being obtained than that which is generally obtained from grain Every stage of the process has been carried on under supervision of U S government inspectors, and the usual licenses have been taken out.

Tests have been performed by other companies with their own staff in the Standard Company's plant, excluding everyone who has been connected with former experiments, entirely confirming the Standard Company's results and resulting in contracts for the use of the plant under license

The utility of this process to lumbermen will immediately be appreciated. The refuse burned will be eliminated, and if a hundred tons of wood waste a day is produced at a mill, 1,200 to 1,500 gallons of alcohol may be made from it, supplying a large quantity of power for other purposes, and still leaving the refuse with its fuel value but little diminished The resins are extracted from pine and similar woods in the process but the residue discharged from the diffusion battery in the alcohol process may be made into briquettes or charcoal, forming a desirable fuel salable at a good profit. Smaller mills making less than 50 tons of waste

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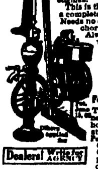

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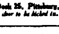

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(*Concluded from page 359*)

a day may profitably combine to operate a joint distillery for the conversion of their refuse into alcohol.

Whereas it may be not a little alarming to the prohibitionists to suggest that a drinkable alcohol may be so cheaply made from sawdust, much as one may deprecate the manufacture of artificial wines and liquors and adulteration with alcohol, it is at least satisfactory that the product of the new process is actually purer than that made from grain.

TRIALS OF THE "NORTH DAKOTA."

(*Continued from page 352.*)

that of the motors being identical.

The five trials of the 'North Dakota" over the mile course gave the following speeds 22 25, 21 48, 22 13, 21 51, and 22 13, the average speed working out at 21.83 knots. She thus not only exceeded the mean speed of the "Delaware" by 0.39 knot, but the turbines exceeded the reciprocating engines by over 5000 horse-power The maximum number of revolutions of her propellers was 286 a minute, and it was found that 263 revolutions were sufficient to maintain the contract speed of 21 knots.

In the four-hour test under full power the "North Dakota" made 21.71 knots for the first two hours, and 21 64 knots in the third hour On the fourth mile the failure of a tube in one of the boilers necessitated the shutting down of four out of the fourteen boilers, but even under this greatly reduced power, the speed of the ship was exactly 21 knots.

A feature which, from the military standpoint, is of the greatest importance is the remarkable steadiness of the ship, even when the turbines are being pushed to the limit. Throughout the greater part of the length of the ship it was scarcely possible to tell, from any vibration, that the engines were in motion This is a feature which is particularly appreciated by ordnance officers, since the vibration which is noticeable on ships driven by reciprocating engines is more or less disturbing to the gun sights. The North Dakota," which is considerably the largest warship yet built for our navy, has been constructed in record time, and the Fore River Company is to be congratulated on the fact that, had it not been for delays in the furnishing of armor they would have cut down the record for construction even more than they have Her dimensions are Total length, 518 feet 9 inches, beam, 85 feet 2½ inches, draft on trial, 27 feet, displacement on trial, 20,000 tons. She is the most completely armored ship afloat. Her main belt, 7 feet 6 inches wide, tapers from 10 inches at its bottom edge to 12 inches at its top edge Above this, extending to the gun deck, is a second belt 8 feet wide, tapering from 10 inches at its bottom edge to 8 inches at the top The 5-inch guns have a protection of 5 inches of armor, and the main turrets and barbettes are protected by 11 inches.

The lines of the ship are particularly fine, in fact, as fine as those of our armored cruisers She will prove to be a splendid vessel when heading into a heavy sea, for not only has she freeboard, due to her forecastle deck, of 27 feet, but she is given a very pronounced outward flare, which should serve to lift her comfortably over the waves, and enable the ship to be driven at full speed in heavy weather An innovation is the placing of the officers' quarters forward under the forecastle deck and in the superstructure immediately abaft of the two forward turrets.

The battery is mounted on the longitudinal axis of the ship, a disposition which originated with our Construction Department, and is being followed by some foreign navies. The placing of all the guns on the center line enables the whole battery to be trained on either beam, giving the ship a broadside discharge either to port or starboard of ten 12-inch guns. This arrangement, it is true, weakens the end-on fire, which, in

(*Concluded on page 361.*)

Home-Made Experimental Apparatus

In addition to the following articles, the Scientific American Supplement has published innumerable papers of immense practical value, of which over 17 000 are listed in a carefully prepared catalogue, which will be sent free of charge to any address. Copies of the Scientific American Supplement cost 10 cents each.

If there is any scientific, mechanical, or engineering subject on which special information is desired, some papers will be found in this catalogue, in which it is fully discussed by competent authority

A few of the many valuable articles on the making of experimental apparatus at home are given in the following list:

ELECTRIC LIGHTING FOR AMATEURS. The article tells how a small and simple experimental installation can be set up at home. Scientific American Supplement 1551

AN ELECTRIC CHIME AND HOW IT MAY BE CONSTRUCTED AT HOME, is described in Scientific American Supplement 1566.

THE CONSTRUCTION OF AN ELECTRIC THERMOSTAT is explained in Scientific American Supplement 1566.

HOW TO MAKE A 100-MILE WIRELESS TELEGRAPH OUTFIT is told by A. Frederick Collins in Scientific American Supplement 1605.

A SIMPLE TRANSFORMER FOR AMATEUR'S USE is so plainly described in Scientific American Supplement 1572 that anyone can make it.

A ¼-H.-P ALTERNATING CURRENT DYNAMO, Scientific American Supplement 1558.

THE CONSTRUCTION OF A SIMPLE PHOTOGRAPHIC AND MICRO-PHOTOGRAPHIC APPARATUS is simply explained in Scientific American Supplement 1574.

A SIMPLE CAMERA-SHUTTER MADE OUT OF A PASTEBOARD BOX, PINS, AND A RUBBER BAND is the subject of an article in Scientific American Supplement 1578.

HOW TO MAKE AN AEROPLANE OR GLIDING MACHINE is explained in Scientific American Supplement 1582, with working drawings.

EXPERIMENTS WITH A LAMP CHIMNEY In this article it is shown how a lamp chimney may serve to indicate the pressure in the interior of a liquid, to explain the meaning of capillary elevation and depression to serve as a hydraulic tourniquet an aspirator and intermittent siphon to demonstrate the ascent of liquids in exhaustive tubes to illustrate the phenomena of the bursting bladder and of the expansive force of gases. Scientific American Supplement 1583

HOW A TANGENT GALVANOMETER CAN BE USED FOR MAKING ELECTRICAL MEASUREMENTS is described in Scientific American Supplement 1554.

THE CONSTRUCTION OF AN INDEPENDENT INTERRUPTER. Clear diagrams giving actual dimensions are published. Scientific American Supplement 1615.

AN EASILY MADE HIGH FREQUENCY APPARATUS WHICH CAN BE USED TO OBTAIN EITHER D'ARSONVAL OR OUDIN CURRENTS is described in Scientific American Supplement 1618. A plunge battery of six cells, a two-inch spark induction coil, a pair of oneplnt Leyden jars, and an inductance coil and all the apparatus required, most of which can be made at home

SIMPLE WIRELESS TELEGRAPH SYSTEMS are described in Scientific American Supplements 1363 and 1381.

THE LOCATION AND ERECTION OF A 100-MILE WIRELESS TELEGRAPH STATION is clearly explained, with the help of diagrams, in Scientific American Supplement 1622.

THE INSTALLATION AND ADJUSTMENT OF A 100-MILE WIRELESS TELEGRAPH OUTFIT, illustrated with diagrams, Scientific American Supplement 1623.

THE MAKING AND THE USING OF A WIRELESS TELEGRAPH TUNING DEVICE, illustrated with diagrams, Scientific American Supplement 1624.

HOW TO MAKE A MAGIC LANTERN, Scientific American Supplement 1546.

THE CONSTRUCTION OF AN EDDY KITE. Scientific American Supplement 1555

THE DEMAGNETIZATION OF A WATCH is thoroughly described in Scientific American Supplement 1561.

HOW A CALORIC OR HOT AIR ENGINE CAN BE MADE AT HOME is well explained with the help of illustrations, in Scientific American Supplement 1573.

THE MAKING OF A RHEOSTAT is outlined in Scientific American Supplement 1594.

Good articles on SMALL WATER MOTORS are contained in Scientific American Supplement 1494, 1549, and 1696.

HOW AN ELECTRIC OVEN CAN BE MADE is explained in Scientific American Supplement 1472.

THE BUILDING OF A STORAGE BATTERY is described in Scientific American Supplement 1433.

A SEWING-MACHINE MOTOR OF SIMPLE DESIGN is described in Scientific American Supplement 1210.

A WHEATSTONE BRIDGE, Scientific American Supplement 1595.

Good articles on INDUCTION COILS are contained in Scientific American Supplements 1514, 1522, and 1527 Full details are given so that the coils can readily be made by anyone.

HOW TO MAKE A TELEPHONE is described in Scientific American Supplement 966.

A MODEL STEAM ENGINE is thoroughly described in Scientific American Supplement, 1527.

HOW TO MAKE A THERMOSTAT is explained in Scientific American Supplements 1561, 1563, and 1566.

ANEROID BAROMETERS, Scientific American Supplements 1500 and 1554.

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Inquiry No. 9034.—For manufacturers of machinery that could reduce stumps to kindling wood.

Inquiry No. [illegible]. Wanted, the address of the manufacturers of "Cycle Ball Bearing Suspenders."

(*Concluded from page 360.*)

these ships, consists of only four guns, as against six guns in several foreign navies, but it is the belief of our naval officers that future engagements will be fought almost entirely broadside to broadside. Personally, we are inclined to the belief that if the third and fourth turrets were staggered, the third being moved over to starboard and the fourth turret to port, the effectiveness of the gunfire would be increased without diminishing the broadside fire.

The foremost pair of guns have a command of 33 feet. The pair immediately astern have a command of 41 feet. Turret No. 3 carries its guns about 39 feet above the sea, and those in the two after turrets have a command of about 25 feet. We shall hope in a later article to give further particulars of the trials of this vessel.

◆

Radiations of Short Wave Length

At the recent meeting of the British Association for the Advancement of Science at Winnipeg Prof. Lyman, of Harvard University described his interesting researches on radiations of very short wave lengths. The radiations involved in ordinary laboratory work are comprised between 6,800 and 2,600 of Angstrom's scale. Schumann has demonstrated the great effect of the atmosphere in limiting the spectrum in the ultra violet region. By the employment of lenses of fluorine Prof. Lyman has extended Schumann's researches, especially to the region between 2 000 and 1 030 Angstrom which exhibits peculiarities of great interest. No visible hydrogen line was found between 2 000 and 1 650. Between 1 650 and 1 030 conspicuous lines of hydrogen were observed but they did not exhibit the grouping which is characteristic of hydrogen lines in other parts of the spectrum. No lines of nitrogen, oxygen, or helium and only a few lines of argon were detected between 2 000 and 1 030. In this region carbon dioxide and carbon monoxide show spectra of many bands. Hydrogen, argon and helium are very transparent to these radiations, but oxygen absorbs them energetically. Here, probably, is the explanation of the opacity of air to these radiations. Prof. Lyman has corrected the limit of absorption by fluorine. This absorption begins at 1 265 Angstrom and not at 846 as had previously been believed. The chemical effects of these radiations of short wave length are very intense. Oxygen especially at low pressures, is strongly ozonized. Gases, in general, are ionized the more strongly as their pressure is lowered. Bumstead has shown that the photochemical action of these radiations is 25 times more intense than that of ordinary ultra violet rays.—*La Nature.*

◆

The Fortieth Birthday of the Post Card.

The first post cards were issued in Austria on October 1st, 1869. The idea had already been suggested, but not adopted, at the fifth German postal congress, in 1865. Its adoption in Austria appears to be due to an article published in 1869 by Prof. Emanuel Hermann of Vienna, who is sometimes called the inventor of the post card. In 1870 post cards were issued by the North German Postal Union, Bavaria, England, and

(*Concluded on page 3[illegible].*)

$1
NEVER FAIL
No. 2 for any old Razor
No 1 for any Style Safety

THE NEVER FAIL CO.,
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Name

Address

City

State

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Then, if you can't say with perfect truth, "Never have I enjoyed such soothing shaves," send it right back at our expense and we'll return your money.

With the Never Fail, every user is at once an expert. You can instantly sharpen any razor—any style blade—and make it better than the day it passed the shop inspector. Better honed sharper than it can be made by the most expert hand operator, and in much less time. Only a few strokes on either side does the trick—five or six seconds. If you use safety blades, the NEVER FAIL WILL MAKE EVERY ONE OF THEM GOOD FOR FROM 50 to 150 PERFECT SHAVES so it will pay for itself in money as well as time saved.

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Remit only a third of the price—and that simply as an evidence of good faith. Could we choose our inquirers we'd gladly send it free. Send just $1.00. Try the Never Fail 15 days. Subject it to the severest tests. Then, if not completely satisfied—if not the best stropper you ever used—if it doesn't do just as we say, send for your money.

There never was a shaving problem; it has always been a sharpening problem. Any man can use a razor provided his blades are properly sharpened.

We could tell you about the way the Never Fail is made, but you don't care to hear it. You only want to be certain of a GOOD stropper, one that will positively end your shaving troubles. We have it in the Never Fail. One dollar and the coupon will prove it, and your dollar is simply on deposit while you judge.

Don't go on shaving the old way—the torturing way. Don't waste time and money and undergo the risks of the barber shop. Shave every day in your own home at the same time you complete the rest of your morning toilet. Carry the clean, well-groomed face to business that every gentleman should. You'll feel better, look better and be time and money ahead. Just clip the coupon, pin a dollar bill to it and mail at our risk.

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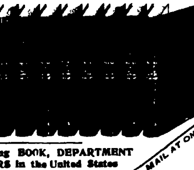

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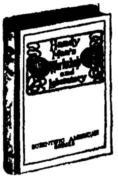

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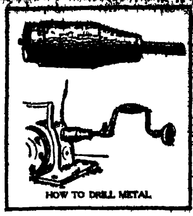

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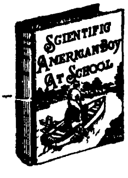

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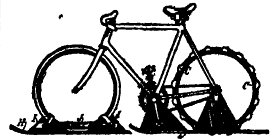

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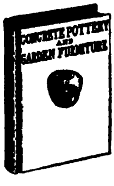

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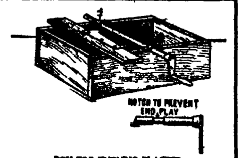

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(Concluded from page 362.)

Switzerland. The German cards were printed without the impression of a stamp until 1872, in which year also the first "private" post cards were issued, in Germany. At the postal congress which met at Berne in 1874, and at which 22 countries were represented, the international post card of the value of 10 pfennigs, 12½ centimes, 1 penny, or 2 cents was adopted. The post card soon became popular and its use extended to other countries. Post cards are now issued in great numbers by 22 governments. In Germany alone more than 1,500 million post cards are used annually.

The private picture post card, which has attained such amazing popularity within the last decade, is nearly as old as the government post card. It is also of German invention and it owes its origin to the Franco-Prussian war. On July 16th, 1870, the first illustrated post card, bearing the picture of a gunner, was placed on sale by Schwartz, in Oldenburg. The manufacture of picture cards was afterward taken up by Brandt in Dresden. The industry, which is still carried on chiefly in Germany, has developed to gigantic proportions. Although many of the cards are striking examples of bad taste and vulgarity it cannot be denied that the best of the so-called art cards and the reproductions of famous paintings and statues have extended the love for the beautiful and that the landscape views have given to many persons some idea of the beauties of their own and foreign lands of which they would otherwise have remained in ignorance.

◆

Expenditure of Muscular Energy in Bicycling.

Bulletin 208 of the U. S. Department of Agriculture contains a description of experiments made by Profs. Benedict and Carpenter, of Wesleyan University, on the expenditure of muscular energy in bicycling. The chief result of the experiments, which were conducted with the aid of the respiration calorimeter, is that in bicycling the muscles of the legs work with an efficiency of 20 to 22 per cent, or, in other words, for each unit of heat produced by the external work of the muscles about four units of heat are lost by radiation, in addition to the heat so lost when the body is at rest. The external work was measured by an ergometer, consisting of a bicycle, the rear wheel of which was replaced by a copper disk, which rotated between the poles of an electromagnet, forming an electromagnetic brake. By this means the work was consumed in the production of induced currents in the disk and was ultimately converted into heat, which was measured by inclosing the whole machine in the calorimeter. The rider was then inclosed, with the machine, in the calorimeter and the heat produced in a definite interval of time was again measured. This heat was made up of three parts; the heat generated in the body in consequence of its muscular activity, the heat which would be evolved in the same time by the body at rest, and the heat produced in the ergometer by the external work of the muscles. The last-named portion had been measured in the preliminary experiment already described, and the second portion was measured by inclosing the man at rest in the calorimeter. These portions having been subtracted from the total quantity of heat produced in the main experiment, the remainder represented the heat generated in the body in consequence of the activity of the muscles employed in bicycling. This remainder was found to be about four times the heat generated in the ergometer, whether the bicyclist worked moderately or strenuously and whether he was experienced or not. Training, therefore, appears to have little effect upon the thermo-dynamical efficiency. It has long been known that the human body is a highly efficient engine, but it should be noted that the high efficiency of 20 to 22 per cent, exhibited in these experiments, has been exceeded by the Diesel and some [illegible] motors.

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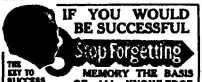

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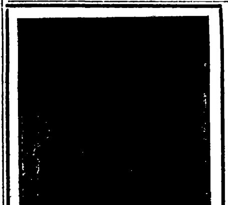

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I. The Chicago and Gulf Waterway.—An illustrated description of Chicago's drainage canal, an engineering work which stands without a parallel in the world.

II. Chicago as a Railroad Center.—Chicago is the greatest railroad center in the world.

III. The Wonderful Grain Trade of Chicago.—Chicago is an enormous wheat bin, into which much of the grain raised in the middle West is poured.

IV. Shipping on the Great Lakes.—Most of the iron ore that is now smelted in Pennsylvania is mined in the middle West. To transport it to the blast furnaces of the East at a cost which will enable American steel makers to compete with foreign steel makers, it has been necessary to devise a new kind of lake transportation. Ships of 10,000 and 12,000 tons burden have been constructed which convey ore at small cost through the Great Lakes, and which are without a counterpart anywhere in the world.

V. The Handling and Shipment of Iron Ore.—The above-mentioned fact that iron ore is mined in the middle West and smelted in the East has necessitated not only the construction of special freight-carrying steamers, but also the designing of special machinery for loading and unloading the ore from the steamers.

VI. Freighting on the Mississippi.—Freighting on the Mississippi is a more important industry than most of us may realize.

VII. The Steel Industry.—One of the greatest steel plants in the world is that which has been built at Gary.

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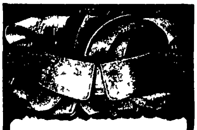

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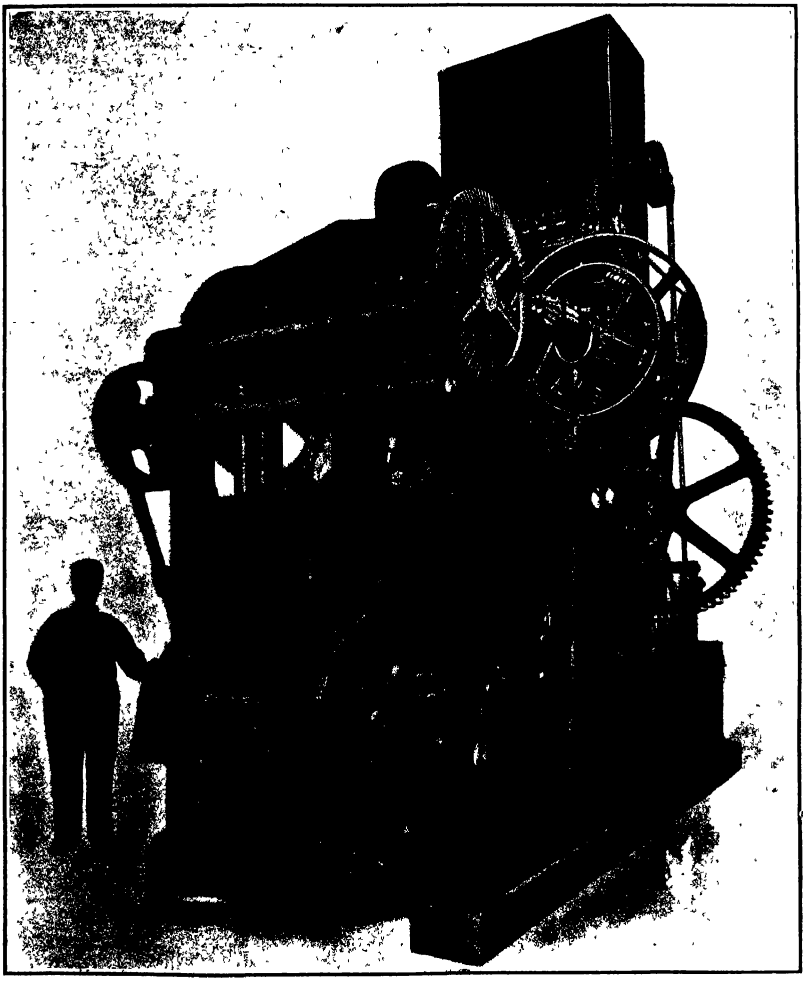

A MACHINE THAT MAKES 40,000 ENAMELED CONCRETE BLOCKS IN TEN HOURS.—[See page 368.]

SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

PURITY OF CATSKILL WATER SUPPLY

The special experts on the purification of water for the New York Board of Water Supply have been investigating local conditions at the Ashokan Reservoir with a view to determine whether the surface soil and vegetation on the bottom and sides of the Ashokan Reservoir should be entirely stripped down to the clay and gravel, as was done in the larger reservoirs of the metropolitan water districts of Massachusetts, or whether some other treatment to obviate deterioration during storage was preferable. It was estimated that the stripping of the soil would cost about $5,000,000. Messrs. Hazen and Fuller, the expert engineers, have decided that the stripping of the Ashokan Reservoir would not prevent tastes and odors in the water to a sufficient extent to warrant the great expenditure. They considered that aeration, at a small fraction of the cost of stripping the reservoir, would result in better water, and that perfectly satisfactory water can be obtained by both aeration and filtration, whether the reservoir is stripped or not. It was recommended that all the trees and bushes over the entire area be cut close to the ground and burned shortly before the area is flooded, and that all the stumps and roots be taken out, so that in case of low water they would not be unsightly. They also recommend that at the outlet of the reservoir a large fountain be built, where all the water drawn out will be thoroughly exposed to light and air.

THE NEW FOURTEEN-INCH ARMY AND NAVY GUNS

Great interest attaches to the new 14-inch gun for the navy which has been delivered at the navy yard at Washington, where it will be rifled and the breech mechanism installed. On completion it will be shipped to the naval proving grounds at Indian Head, Maryland, for a test. The completed gun will weigh about 63 tons, its projectile will weigh about 1,400 pounds, and the latter will be propelled by a charge of 365 pounds of powder. The extreme range at maximum elevation will be more than twenty-five miles. As compared with the present navy 12-inch gun, this will be a far more powerful weapon. It will penetrate any armor afloat, at the most distant ranges at which accurate aiming is possible. The army has also a 14-inch gun of much lower velocity and power, which will soon be tested at the Sandy Hook proving grounds. The lower muzzle velocity (about 2,000 feet per second) of the 14-inch gun will give it additional life over the 12-inch gun. After some eighty discharges the rifling of the present 12-inch gun of 2,500 foot-seconds velocity becomes so badly worn as to destroy the accuracy. In the case of the 14-inch gun the erosion is much less, and the gun will be serviceable for about 300 discharges.

THE NEW BRITISH AND GERMAN "DREADNOUGHTS."

The biggest "Dreadnought" of Great Britain and the most powerful German vessel of the same type were put into the water on the same day. The "Neptune," the English vessel, has a displacement of 20,250 tons, will carry ten 12-inch guns and twenty 4-inch guns, and her total broadside will weigh 9,120 pounds. The German "Dreadnought" "Ostfriesland" has a displacement of 19,000 tons, will carry twelve 12-inch guns, twelve 6.7-inch guns, and twenty-two 4-inch guns, and she will deliver 14,204 pounds in a single discharge of all her guns. The most remarkable feature of the "Neptune" will be the extraordinary power of concentrating the gunfire. The ten 12-inch guns will be mounted in pairs in five barbettes. One barbette will be placed in the forecastle on a high level. The two broadside barbettes will be *en échelon*, that on the port side being more forward than the barbette on the starboard side. By a novel arrangement the superstructure is bridged over these two barbettes, both pairs of guns being fired on either side at once if required. Of the two barbettes astern, one will be raised above the other, so that all four guns can be fired direct astern simultaneously. The broadside fire of the "Neptune" will thus be ten guns, the stern fire eight guns, and the direct-ahead fire six guns. The "Ostfriesland," on the other hand, has four of her twelve guns masked by the superstructure, and can fire only eight 12-inch guns on either broadside. Her end-on fire will be six guns ahead and astern.

ACCELERATION OF LONG-DISTANCE EXPRESS SERVICE.

Hitherto the trip from New York to St. Louis has been a rather trying one. Now, however, conditions are ameliorated by two through trains which make a schedule run from New York to St. Louis in twenty-four hours. The New York Central train leaves at 2:45 in the afternoon, and the Pennsylvania train at 6:25 P. M. The Central's train is a duplicate of the "Twentieth Century Limited," and the Pennsylvania's is a duplicate of its eighteen-hour "Chicago Flier." The Central train is due to arrive in St. Louis at 1:45 P. M., which, allowing for the difference in time, makes a run of just twenty-four hours. The time saved is about five hours, and both of the trains are luxurious in the extreme. There are now seventeen trains daily each way on the New York Central and Pennsylvania systems.

THE LIMIT OF RAPID TRANSIT

If all mechanical difficulties could be overcome and sufficient horse-power could be developed, what would be the minimum time in which passengers could be transported, say from New York to Philadelphia? At first glance, one is apt to overlook the fact that the freight to be transported is not mechanical, but human, and this is a very important factor in the problem, because the safety and comfort of the passengers must be considered. It is really a question of starting and stopping that imposes a limit on the reduction of time consumed in transit. A very interesting discussion of the question has been received from one of the readers of the SCIENTIFIC AMERICAN. He points to the fact that the quickest way to get from one place to another without shock or jar is to travel faster and faster until half the distance is covered, and then to slow down until the destination is reached. When the rate of acceleration is just such as can be borne with comfort, the limit is attained. The effect on the passengers would be a continuous pressure against the back of the seat, of the sort experienced when a car is started suddenly, for the first half of the journey, and then in order to prevent them from pitching out of their seats the chairs would have to be turned in the opposite direction for the rest of the journey, during which the same sensation would be felt. If an attempt were made to make the same time by any other method involving uniform speed throughout the greater part of the journey, an unpleasant jar or pressure would be experienced in starting and stopping. The highest speed attainable would therefore be proportional to the distance traversed.

Our correspondent draws a fanciful picture of the railroad of the future, which would permit of such rapid transit. The trains would have to run in a vacuum to prevent them from being heated to incandescence by the resistance of the air. They would also have to be held in suspension in the vacuum tube through which they travel, for the slightest contact with the sides of the tube would result in enormous friction. The cars might be held in suspension by the repulsion of opposing magnets on the cars and tube respectively. When thus isolated, they could be propelled only by the magic power of magnetism. Under such conditions, the energy consumed in propelling the car would be quite low. The running time on such a road between New York and Philadelphia or New York and Boston would be a matter of a few minutes. The time for each half of the distances could be calculated from the well-known formula, $S = \frac{1}{2} a t^2$, where S is the distance, here *half* the whole journey, a, the acceleration, or change of speed each second, and t, the time in seconds. Taking an acceleration of 11 feet per second each second, which would bring to rest, in 4 seconds, a train moving at 30 miles per hour (44 feet per second), he finds that the time from New York to Philadelphia (85 miles) and from New York to Boston (190 miles) would be 6 minutes 44 seconds and 10 minutes 4 seconds respectively.

This may indeed be considered the absolute limit of rapid transit; for the passengers would be traveling each half of the distance one-third as fast as they could fall through the same space under the attraction of gravity.

THE OTHER HALF OF THE CULLINAN.

It is reported in African papers that the original stone, of which the Cullinan was a portion, has been found in the possession of the Kaffirs of the Magatus tribe in Zoutpansberg. The dimensions of this second Cullinan stone have been given as 4,322 karats.

This story has been denied by the Transvaal Department of Mines, and an official of the treasury in Pretoria states that the origin of the legend can undoubtedly be traced to the belief that enormous quantities of diamonds were buried by command of the celebrated chieftain's wife Majatje during the Boer war. These diamonds became the spoil of the Kaffirs when they returned to Kimberley. But these treasures are lost, for the Kaffirs who buried them are dead, and search for them has been without result.

The possibility of finding still larger stones than the Cullinan in the soil of South Africa is, however, by no means remote. G. A. Molengraaff, professor of mineralogy in the Technical High School at Delft, recently stated that the Cullinan is only a portion of a much larger stone, the original form of which can only approximately be indicated. Four pieces must have been broken off from the original stone by natural crystal cleavage, which is evident from the cleavage planes. Each of these pieces must have been of considerable size. Accordingly, the natural end planes (called "nijf" in the language of the diamond workers) are only partially shown in the Cullinan. Most of the crystal planes are cleavage planes. The original portion of the surface shows only a single octahedral face; it also has an irregular curved front surface bearing some resemblance to the six faces of a dodecahedron, and a very irregularly formed cubical (hexahedral) surface, in which the quadrangular impressions can be recognized. These quadrangular impressions are characteristic of minerals such as diamonds, which occur in the octahedral form. The Cullinan consists of a single crystal; there are no traces either of a twin crystal or of twin lamellæ. It is completely transparent and colorless. Its transparency can be best compared with that of very pure ice, or with the complete clearness of the variety of opal known in the mineral kingdom as hyalite (principally consisting of silicic acid). It is true that the Cullinan contains a few impurities in the shape of inclosed grains, also some internal cleavages of fragmentary character called "glessen" in the Dutch diamond trade, but their situation is such that they do not injure the value of the stone as a jewel. In any case the Cullinan is the purest of all large precious stones hitherto found.

The question now arises whether there is a possibility of finding the pieces broken off by crystal cleavage. That they can be found is certain, but it is impossible to predict whether they are now in diamond mines or elsewhere. The diamond is formed, as is known, at great depths by the decomposition of carbon, dissolved in the molten basic plutonic magma of the earth. (The so-called 'blue-earth' is formed at a later period from this rock.) The carbon was then, under enormous pressure and at the very high temperature prevailing at these depths, deposited from the molten rock in the form of diamonds. During the volcanic discharges of the masses of rock the diamond was forced upward with tremendous force, and the very great friction to which the mass was exposed during its passage through the crater shaft caused the cleavage of the stone according to crystallographic laws to which we have referred. It is therefore not impossible that the broken-off fragments of the Cullinan are scattered over a wide space, and that they may one day be found on the surface of the earth, but it is just as possible that they are still reposing in the depths of the mines. Sir William Crookes has also lately expressed the opinion that the Cullinan is the smaller portion of an octahedron broken by crystal cleavage.

◆

New applications of electricity are being discovered daily, but not every new application is of as much interest or importance as one recently developed for purifying the air of reading rooms, theaters, and other close places where large numbers congregate. The apparatus referred to is the ozone generator installed recently in the Chicago Public Library to purify or ozonize the 10,000 cubic feet of air per minute that is forced into the main reading room. After the installation of the ozonizing apparatus it was found that the main reading room was completely deodorized, the air being freed of that disagreeable and deleterious odor which for years had so thoroughly permeated all papers, books, furnishings, etc., in this large room. The fresh sterilized "mountain" air in the room reduced the humidity during the hot, oppressive days of summer, and greatly increased the comfort of the readers and employees. The installation renders the disinfecting of all books, periodicals, papers, etc., on the shelves, racks, tables, etc., an automatic process, keeping them constantly in a hygienic condition.

ENGINEERING.

The North British Locomotive Company has recently completed and tested the first steam turbine locomotive, and it is said to be entirely successful.

The great shops of the Pennsylvania Railroad Company at Altoona, employing 13,000 men, are now working full time. This is the first time since the financial depression of 1907 that all departments of the great shops have been operated.

A non-shrinking alloy can be produced by melting together 50 pounds of tin and 50 pounds of zinc This gives a hard alloy if a good grade of zinc is used Two pounds of bismuth will render it very fluid and enable it to be poured at a lower temperature

Work is being pushed on the Cape Cod Canal A big granite breakwater is being constructed in Cape Cod Bay to protect the end of the canal and furnish anchorage for shipping. At the other end, in Buzzard s Bay, work is also proceeding at a fair rate

A new trolley car is being experimented with in New York city The new car is operated by gasoline, and is also supplied with an electric equipment. In the event of a blockade or accident on the road, the new cars can be switched over to another track and be run by gasoline. Riding in the car is very much like riding in an automobile, there being an entire absence of the jerk which is so disagreeable in electric cars. The radiator is on the roof

A twenty-four-hour test of the 'North Dakota" at a 12-knot speed was finished November 7th The consumption of coal and water was well below the guaranteed mean amount. The consumption tests of this battleship are therefore in keeping with the remarkable speed shown in her special mile trials. It has been found that her turbine engines have developed a greater top speed and generated power for a low speed at less expense for coal and oil supplies than did the reciprocating engines of the "Delaware"

The Board of Estimate of the City of New York has approved the action of the Public Service Commission in awarding contracts for the construction of the Fourth Avenue subway in Brooklyn and work on this very much needed improvement will proceed at once The contracts were sent to the Board of Estimate over a year and a half ago, and have been held up ever since. As the building of subways under the best conditions cannot keep pace with the increase in population, it is to be hoped that there will be no such senseless delays in authorizing future subways

An exhibition was recently made of Mr Louis Brennan's monorail car which, it will be recalled, is held in upright position by means of gyroscopes. Since the first announcement of his invention, Mr Brennan has been at work developing the car to practical dimensions and the present model is large enough to contain forty passengers. The car was operated both on a straight and a circular track, and maintained its equilibrium perfectly So sensitive was it to the shifting of the center of gravity, that when the passengers all crowded over to one side, the car immediately righted itself and maintained its horizontal position. Mr Brennan overcomes the precession by means of frictional devices acting on the gyroscope wheels.

The Baldwin Locomotive Works has just completed for the Atchison, Topeka & Santa Fé Railway the most powerful passenger locomotive now in use Apart from its tender this locomotive weighs 376 450 pounds, and is 65 feet long. The tender carries 12 000 gallons of water and 4,000 gallons of oil, which will be used as fuel. The length of the locomotive and tender is 105 feet. The tractive power of the locomotive is 53,000 pounds. There are five pairs of driving wheels, 73 inches in diameter, working in sets of two, the locomotive being of the Mallet articulated type. The locomotive is the first for passenger service to be built of this type, and is the first to combine feed-water heater, superheater and reheater in one machine. Its firebox is built on an entirely new plan which eliminates staybolts.

The October Engineering Review gives an admirable illustrated account of the progress of work on the Los Angeles aqueduct, now about half completed It is probably little realized, away from southern California, that this is by far the largest hydraulic engineering work now in progress, with the exception of the Panama Canal It speaks well for the courage of the people of Los Angeles, and their faith in the future of their city and district, that they should meet by this immense undertaking the serious problem of a waning water supply coupled with a growing population. The aqueduct will be 240 miles long, and will be capable of conveying 260 million gallons of water per day from the Sierra Nevada across the Mojave Desert to San Fernando Valley, providing sufficient water for power purposes and irrigation of the district, as well as for the city supply. Practically the entire work, including tunnels, steel siphons, and concrete-lined and covered canal, is being done by the city under the direction of its own engineers.

ELECTRICITY.

The city of Baltimore is evidently favorable to municipal ownership The problem of lighting the streets is being investigated In September, 1910, the contract for lighting the city expires, and hopes are entertained that a municipal plant will by that time be ready to furnish power for the street lamps

Following a test of gas-electric motor cars between Manassas and Strasburg, Virginia, the Southern Railway Company has bought two of these cars from the General Electric Company Each car is equipped with a pair of 100-horse-power motors operated on a voltage of 600 The current is generated by an 8-cylinder gas engine The cars are 55 feet long and will seat 52 passengers.

The Third Avenue Railroad Company of this city is experimenting with gasoline-electric power on its 125th Street crosstown line. The requirements call for a car which can run up a five per cent grade and which can maintain a schedule of eight miles per hour with ten stops per mile. So far the results have been very satisfactory, the car has successfully run up an eight per cent grade and is keeping its schedule

The new Blackstone Hotel in Chicago is provided with an unusually complete electrical equipment. In the kitchen particularly extensive use is made of electrical labor-saving devices. There are electric dish elevators, dish washers, vegetable parers, dough mixers, silver-polishing machines etc The laundry of the hotel is also completely equipped with electrically driven laundry machinery of every description

Before the advent of the metallic-filament street lamp gas lamps were largely used in English cities to illuminate the side streets, as the requirements did not justify the use of flaming arc lamps. Now the gas lamps are giving way to the metal filament lamps which afford a considerable saving Nearly two thousand side street lamps at Marylebone have been changed from gas to electricity, with the result that $7 500 has been saved

The Railroad Commission of Indiana has been ordered to investigate the various types of headlights for locomotives and when the best one has been discovered, to require the use of this headlight on every railroad in the State The tests have recently been undertaken near Avon Ind to determine the relative efficiency of oil and electric headlights The effect of opposing headlights, the distances at which obstructions on the track could be detected and the effect of observing signals were investigated, but as yet no conclusions have been reached

A new form of electro-magnetic clutch has recently been devised in which a stationary electro-magnet is used to draw the clutch members together into frictional engagement The magnet coil is placed between flanges formed on the two members of the clutch and when it is energized it attracts the clutch members with sufficient force to permit one to drive the other When the current is cut off, a spring serves to separate the clutch members. The advantage of this system lies in the fact that the magnet does not come in contact with the parts it actuates

The Electric Railway Journal calls attention to the many problems which arose in modernizing the traction system of Bombay As the average daily income of the inhabitants is but 25 cents, five-cent fares are out of the question The fare is two cents for a seven mile ride, while the average fare is one anna or one and one-third cents In order to withstand the ravages of insects special varieties of wood had to be used in the cars and track system Even the overhead system had to be modified so as to permit of the passage of the tall shrines used by the natives in their religious pageants

Practically all the coal consumed in Brazil is imported As a consequence the cost of fuel is very high and this has done a great deal to prevent the growth of manufacturing industries. However advantage is now being taken of the water power of the country A recent consular report points out the development of hydro-electric power systems around Rio de Janeiro, showing that many manufacturing concerns are changing from steam to electricity and it is hoped that the industrial development will be largely increased because of the greater advantages and the economy of using electric power

The new articulated electric locomotives of the Pennsylvania Railroad for service in the New York and Long Island section virtually are two separate locomotives coupled together The motive power comprises a pair of 2,000-horse-power direct-current interpole motors, which are crank-connected to the driving wheels. The locomotives are required to start a 550-ton train on a two per cent grade and must have a tractive effort of 60,000 pounds Although a speed of sixty miles per hour was called for in the specifications, the locomotive now under test has made seventy two miles per hour. The weight of the locomotive is 332,160 pounds.

SCIENCE.

Lieut. E H Shackleton who returned from an Antarctic expedition early this year, after reaching a point within 111 miles of the pole, has been knighted by the King of England

Arrangements will shortly be made by the Austrian government for the public sale of radium for medical and experimental purposes The total quantity of radium which has been thus far recovered for scientific use throughout the world is estimated not to exceed a quarter of a pound

The Harvard Observatory announces that a photograph of the spectrum of Morehouse s comet taken on November 17th 1908 with an eight inch telescope shows six broad bright bands These bands appear to coincide with the hydrogen lines zeta epsilon, delta, gamma beta and the strong bright band at wave length 464 to 473 characteristic of spectra of the fifth type

Tantalum is a rare metal of slight importance the only practical use to which it is now known to be put being in making filaments for incandescent electric lamps The efficiency of the tantalum lamp is greater than that of the carbon lamp but somewhat less than that of the lamp with tungsten filament As more than 20 000 filaments of 20 candle-power can be made from a pound of tantalum the market is not large It is at present probably supplied by rich manganotantalates from western Australia No tantalum minerals are known to have been produced in the United States in 1908 according to F L Hess whose report on various rare metals forms an advance chapter of Mineral resources of the United States calendar year 1908 published by the Geological Survey The tantalum used in the manufacture of lamps in this country is made in Germany and imported at a cost of $ 00 or more a pound

A great daylight meteor of October 6th was observed by many persons in various parts of England The particulars to hand are not very definite and it is scarcely possible to compute the real path of the object From a comparison of about fifteen descriptions W F Denning states in Nature that there seems little doubt that the meteor moved in a direction from south to north over Reading Thame and on to a termination near Market Harborough The radiant point was in Leo and it is hoped that more observations of an exact character will be supplied The sky was clear over a large extent of England and hundreds of persons saw the meteor though only a small proportion of that number have reported their observations The great daylight meteor of 1900 January 9th was directed from Aquila that of 1891 February 8th emanated from Hercules It is seldom that meteors appearing at such times can be suitably observed as the sky does not afford any reference objects such as is furnished by the stars at night.

Before timber is subjected to preservative treatment it is customary to remove the bark Unless this is done very thoroughly however patches of the inner bark will remain on the wood Until recently it does not seem to have been realized that this bark presented a very effectual hindrance to the penetration of creosote The same thing was discovered by the management of one of the large creosoting companies in the South and steps were immediately taken to see that every particle of bark was removed from piling and other timbers While it is probable that the bark of all species is not as resistant as that of pine it is not known how the different species rank in this respect. In the creosote treatment of timbers it is rarely that the entire stick is penetrated by the preservative The value of the treatment consists largely in the creating of an exterior antiseptic zone around the untreated interior portion If this outer zone be broken the value of the treatment is to a large extent lost.

Recent investigations by the United States Geological Survey have shown that oxygen so essential to all life forms in coal an impurity that is almost as injurious as the ash content Oxygen and ash are of very nearly equal negative value ash being probably a little more injurious in most coals The calorific value of coals in general is indicated by the balance between the total carbon on the one hand and the sum of the two great impurities oxygen and ash on the other The practical application of these statements appears in considering the effect of the exposure of coal to the weather The weathering of the lower grades especially lignites, bituminous coals and peats is marked by the accession of oxygen which is taken into combination This increase of the oxygen content permits a calorific deficiency which on account of the high anticalorific value of oxygen is often serious. It is possible that in many cases considerable increase of oxygen and consequent loss of efficiency are suffered by the lower-class fuels between removal from the bed and consumption and it is probable that in the sub-bituminous coals and more especially in the lignites, oxygenation begins immediately after the coal is blasted from the face in the mine

SOMETHING NEW IN CONCRETE BLOCK MAKING

BY R. H. HUNTING

Of the many recent applications of concrete to the building industry in this country, few, if any, have attracted more attention than the process invented by a Des Moines Iowa, man for the manufacture of enameled concrete blocks A machine of gigantic proportions performs the many operations through which the block passes without the aid of the human hand, turning out 40 000 perfect blocks in each day of ten hours, each one an exact duplicate of every other in form and color

The machine is 13 feet 8 inches in height, 17 feet in length, 6 feet in width, and weighs over 70,000 pounds. In the accompanying illustrations a man is shown standing beside the machine. This comparison gives a good idea of the machine's great size

The process for the manufacture of the blocks as before stated is automatic from first to last The raw material, including cement sand, and gravel (or crushed stone), is first screened, and then workmen separate the aggregates into several sizes to eliminate voids and give added strength to the finished product.

The ingredients are then mixed dry, after which a sufficient quantity of water is added to bring the mixture to a proper consistency This mixture is then fed into an agitator, where it is kept under continual motion and permitted to flow into eight individual scale hoppers, each weighing the exact amount of material required for a single block. Then in unison those hoppers are dumped through receiving spouts into the molds which form the block, these being prepared in advance for the reception of this material

While the above process is going on, a similar one for the preparation of the material forming the enameled part of the block is taking place in another part of the machine. This also starts by taking a dry mixture from individual bins, and measuring it automatically in a receptacle known as the reserve tank At this time also the proper amount of coloring matter is added, so that blocks of a uniform shade may be produced.

Any color or combination of colors may be used, and no matter whether one, one hundred, or one thousand blocks are made, the same shade is produced in each one

Water is next added after being automatically measured, and from the reserve tank the material is discharged into a receiving tank, a part of the machine proper with which are connected eight dipping cups conveying the material in a liquid form to the individual molds.

The molds are now ready for the body material, which has been in preparation as already described, and with the next movement of the machine an intimate association is effected between the two by the enormous pressure of 3,200,000 pounds applied to produce perfect cohesion

A CONCRETE BLOCK MACHINE WEIGHING 70,000 POUNDS.

The molds move forward until they reach the releasing section of the machine, where the blocks are ejected, eight at a time, upon a pallet and loaded intact by workmen upon a car especially constructed for the purpose.

They are now conveyed to suitable storage, where they are allowed to season, no burning being required Nature finishes the work by a process of crystallization, which gives each block a perfect surface without danger of distortion, as commonly results from burning clay bricks.

The illustration shows the machine to consist of a rotary carrier consisting of thirty mold frames, each containing eight individual molds. At each movement of the machine several of these molds are receiving material at various fixed points, one group the enameling material, one the body material, while a third is submitting to the tremendous pressure which unites the two. After the application of this pressure, the next motion delivers the blocks contained in one mold frame upon the pallet as described elsewhere.

Anyone familiar with the process of manufacturing clay brick will readily realize the tremendous saving of time and expense accomplished by this process of manufacture. It has been estimated that the cost of sorting clay brick for quality and color is not less than $6 per thousand This work of course is entirely done away with, as the enameled concrete blocks are absolutely uniform as to size and shape, and there can be no variation in color.

While especially designed for the manufacture of blocks, this is not the only function of the machine. Tile of various shapes, sizes, and colors are also produced by it with equal facility

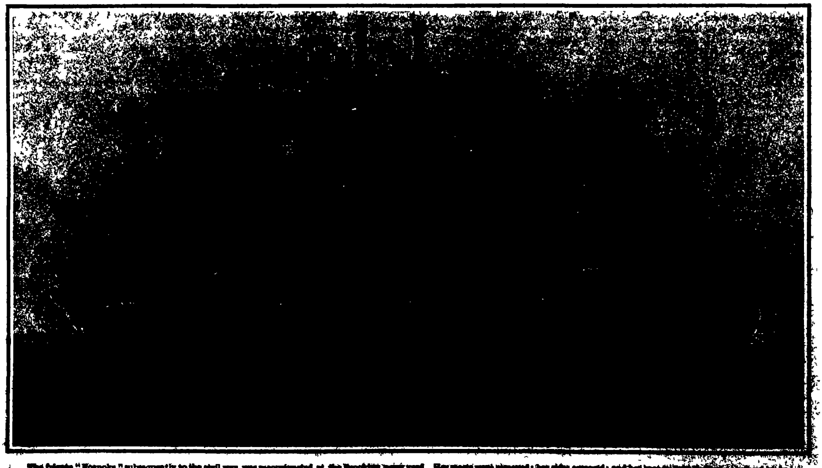
Though not in general use thus far owing to the inability of the manufacturers at the present time to supply the demand, the machine has nevertheless received exhaustive tests, and in each has given entire satisfaction. As for the material it produces, there can be no doubt as to its becoming popular. Our forests are rapidly disappearing, stone is prohibitive because of its expense, and the prospective builder turns with satisfaction to this comparatively new material, which recommends itself not only because of its cheapness, but because of its great lasting qualities.

A "DREADNOUGHT" OF 1863

[The correspondent who sends us the photograph of an engraving from which the accompanying illustration of the "Roanoke" is reproduced, believes that this United States warship is entitled to be considered as the prototype of the modern "Dreadnought." We doubt if any early vessel can be quoted as having a stronger claim to be regarded as the first warship of this type.—Ed.]

To the Editor of the Scientific American

In the battleships of the "Lord Nelson" class of 1906, the British had come to about the limit of their intermediate battery, which consisted of ten 9 2-inch guns, these being substituted for the four 9 2 and ten



The frigate "Roanoke," subsequently to the civil war, was reconstructed at the Brooklyn navy yard. Her masts were [illegible]; her sides armored; and her broadside battery [illegible] by an all-big-gun armament of six heavy guns mounted in three armored turrets. The correspondent who sent us the above illustration suggests that she was the first of the "Dreadnought" type.

U. S. S. "ROANOKE," 1863. IS THIS THE PROTOTYPE OF THE MODERN "DREADNOUGHT"?

[illegible] of the "King Edward VII." class launched three years previous. In this same year they also launched their first "all-big-gun" ship, the "Dreadnought," by abolishing the 9.2-inch guns, substituting in their place six 12-inch guns, and adding these to the four 12-inch guns, which the other two classes already had, making ten in all, and placing them in pairs in five turrets. This is the ship that in three years has revolutionized the navies of the world, all of whom are now building this class known as "Dreadnoughts." But was not this idea of the "all-big-gun" ship taken from one that was first produced in the American navy?

The definition of a "Dreadnought,' as I understand it, is an armored ship with a high freeboard, carrying only guns of the largest caliber in use, these arranged on one deck in pairs and in armored turrets, the number of turrets not being restricted necessarily to five, can be one more or one less according to the tonnage of the ship.

In 1852 there was a steam frigate built by the United States at the Gosport navy yard at Norfolk, Va., and called the "Roanoke." She was 265 feet in length, with a breadth of 52½ feet, and a depth of 26. Her machinery was built by the Tredegar Iron Works at Richmond, Va., and consisted of a pair of trunk engines with cylinders 72 inches diameter and 26 inches stroke.

This frigate was anchored in Hampton Roads at the time of the battle between the "Monitor" and "Merrimac." After this fight, which introduced to the world the revolving armored turret with its pair of heaviest guns afloat (15-inch smooth-bores) she was taken to New York and razed at the Brooklyn navy yard Her masts and sails were removed, her sides were armored, and she was equipped with three Ericsson turrets at the Novelty Iron Works in 1863. Each of the turrets contained a pair of the heaviest guns in use, and they were placed fore and aft on the center line of the vessel, which is the arrangement of the turrets on American "Dreadnoughts." The vessel had no masts and no secondary or auxiliary battery, only the "all-big-gun" armament.

It seems to me that the "Roanoke" complies in every way with the definition of the modern "Dreadnought", that the idea of the "Dreadnought" was first developed in her, and that she was the first "Dreadnought"—or in other words, the great 'Dreadnoughts" are developed "Roanokes" Their arrangement of guns, armor, and turrets is from her The "Roanoke" had no military or skeleton masts or rapid fire guns, these at that time not being necessary, as wireless telegraphy and torpedo boats were not then known.

The American navy had the first steam vessel of war and the first 'Monitor," and should it not be credited with the first "all-big-gun" ship, the "Roanoke," of which the "Dreadnoughts" are but an enlargement of the same idea? I inclose a photograph of the "Roanoke," taken from a large lithograph made for the Navy Department, and presented to me by the Assistant Secretary, G V Fox, with a number of others in 1863.

William Borrum Wetmore.

Allenhurst, N J

POWER INDICATOR FOR INTERNAL-COMBUSTION ENGINES.

A strikingly novel instrument, the invention of Prof N Monroe Hopkins of the George Washington University, is pictured in the accompanying engravings. The instrument is a combination power indicator and precision speedometer without a flexible shaft, and when the equipment is installed upon a stationary engine, automobile, motor boat, or aeroplane, shows what the cylinders of the engine are doing separately or together, which, if any, cylinder is missing, the power of the engine and the conditions under which it is doing the most useful work, how to adjust the carbureter perfectly when the engine is idle as well as under load, speed with absolute precision from 1 to 60 or 100 miles per hour, and mileage, and the revolutions per minute of the propeller in aeroplane and marine work

Interior details of the indicator

The instrument is an original application of the fact that an electric current is produced by the simple heating of the junction of two dissimilar metals, and the magnitude of the current so generated is proportional to the junction temperature

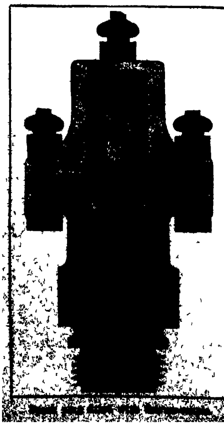
Ordinary thermo-couples as evolved by Becquerel, and used for general temperature measurement in the arts and sciences, would never "live to operate under the high temperature and peculiar chemical conditions in a gasoline engine cylinder, because they would become so heated as to preignite the charge and cause the gas engine to buck, hitch, or back fire and in addition would become brittle and drop apart either through oxidation or the absorption of carbon after a short period of use Actual temperature measurements by means of thermo-couples or thermometers could not be made in gasoline engine cylinders

Prof Hopkins's thermo-couples are of original construction and are designed to give an idea of the temperature in a gasoline engine without actually attempting to measure it. His instrument faithfully and continuously shows, by modified temperature readings, the working conditions of gasoline engine cylinders. The 'thermo-plugs give the same electrical pressures after 50 000 miles use on an automobile as when first applied

One of the illustrations shows a sectional view of a combination firing and indicating plug The thermo-couple may be seen at *A* It consists of special alloys drawn into wires surrounded by massive metal tubes closely fitting the wires and adjustably receiving them These metal tubes are connected at their upper ends through the agency of heavy metal lugs connecting with the binding posts and dissipate the heat by conducting it at a predetermined rate away from the tip of the thermocouple within the engine cylinder to the binding posts without All plugs are calibrated and are interchangeable The adjustment in such plug being obtained by sliding the thermocouple wires through the heavy metal tubes to a greater or lesser distance into the engine cylinder Stuffing boxes screw on to the top of the metal tubes making a gas tight joint between the thermo-couple wires and said tubes. In practice they protrude beyond the lower end of the metal tubes about 3/64 of an inch.

An engine should have these specially constructed thermo-couples in each spark plug They may be selectively or collectively connected with an electrical indicating instrument which gives an accurate reading of the current delivered by one particular cylinder or by the combined cylinders if the spark plugs be connected in series

There is a switch on the instrument for obtaining separate or combined cylinder indications The instrument has two scales the upper a speed scale and the lower a power scale On the switch there is also a speed contact *S* which connects a small magneto-dynamo with the indicating instrument and electrical current is furnished in direct proportion to the speed at which the dynamo is driven In addition to this com



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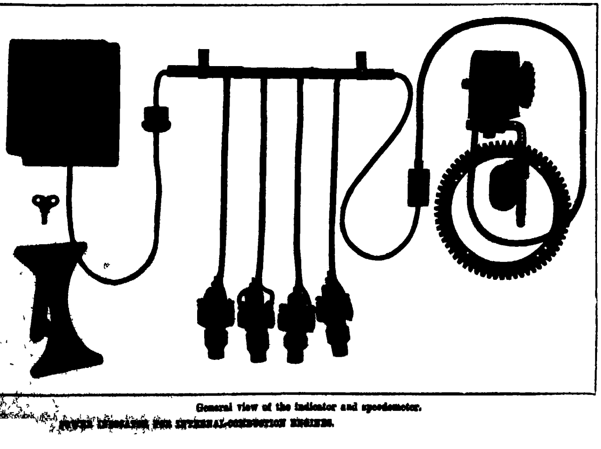


General view of the indicator and speedometer.

POWER INDICATOR FOR INTERNAL-COMBUSTION ENGINES.

bination speedometer and dynamometer, Dr Hopkins has also invented an electric speedometer indicator and tachometer of great sensitiveness and accuracy

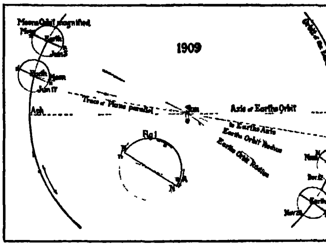
* * *

THE SOLAR AND LUNAR ECLIPSES OF 1909

BY PROF FREDERIC R. HONEY, TRINITY COLLEGE.

The intervals of time between the dates of the eclipses of the sun and moon this year, which occur alternately, illustrate the effect of the rotation of the plane of the moon's orbit in a direction contrary to her orbital motion. If this plane moved parallel to itself, there would never be more than two eclipse seasons in the year, and eclipses would occur when the earth would be at or near opposite points in its orbit, at average intervals alternately of a little more and a little less than six months. This inequality, due to the eccentricity, would evidently disappear if the line of nodes were always parallel to the axis of the orbit.

Fig. 1 illustrates the rotation of the *moon's orbit between the months of* June and December this year The lines *nn'* and *NN'* are drawn parallel respectively to the line of nodes for these months The angle included between them is about 9 degrees. The arrow *A* shows the direction of rotation of the orbit, the arrow *a*, that of the moon's motion The rotation of the line of nodes into the position *NN'* obviously will bring it into coincidence with the radius of the earth's orbit at an earlier date than the line *nn'*, which will coincide with the orbit radius when the earth has reached the opposite point in its orbit.



ROTATION OF MOON'S ORBIT BETWEEN JUNE AND DECEMBER.

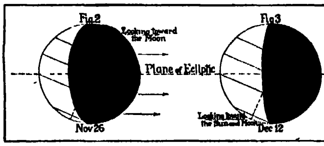
The eclipses of both the sun and moon in June occurred when the moon was in that part of her orbit which was *above* the plane of the ecliptic The eclipses in November and December will occur when the moon will be *below* that plane. In order to show this clearly, it is necessary to represent the moon's orbit on a scale very much greater than that of the earth's orbit, only a portion of which, including perihelion and aphelion, is plotted The position of the earth is shown for the dates of the eclipses on June 3 d 13 3 h. and 17 d 11 5 h, also for November 26 d 20 75 h, and December 12 d. 8 15 h, Greenwich mean time. Since the diameter of the moon's orbit is less than a half a million miles it would be correctly represented in the plot by a diameter a little less than a third of the linear eccentricity of the earth's orbit (= *e*) The dimension has been magnified *forty* times, in order to show the earth's and moon's orbit radii and the line of nodes clearly, which would be indistinguishable by the smaller scale It should be noted that in magnifying the moon's orbit, the relation between these lines is not disturbed, that is, the angles included between them are preserved In the drawing the diameter is enlarged sufficiently to show that on June 3rd, the date of the first lunar eclipse this year, when the earth's and moon's orbit radii were projected in the same line on the plane of the ecliptic, the moon was approaching the descending node *n'*, and was above the plane of the ecliptic. On June 17th, the date of the solar eclipse, the plot shows that the moon had recently passed the ascending node *n* but her distance was so far from the node and above the plane of the ecliptic, that while the eclipse was central, the moon's shadow was projected on the earth very near the north pole.

On November 26th the date of the total eclipse of the moon, the plot shows that the moon will be below the ecliptic and approaching the ascending node *N* On December 12th the date of the partial eclipse of the sun, the moon will be below the ecliptic and will have recently passed the descending node *N'* The distance below the ecliptic will be so great, that the eclipse will be visible principally in the region of the south pole.

The enlarged plot of the moon's orbit shows the position of the moon at Greenwich noon for each day from November 21st to December 18th, and also at the dates of the eclipses. On November 26th, when the moon will be near perigee *P* and very nearly a minimum distance from the earth, she will come wholly within the earth's shadow On December 12th the enlarged plot shows more clearly the great distance between the moon and the node at the time of the eclipse of the sun These plots may be compared with those printed in the SCIENTIFIC AMERICAN for May 15th, 1909 ("The Lunar and Solar Eclipses in June, 1909"). Figs. 2 and 3 are projections of the earth on a plane parallel to its axis, and perpendicular to the plane of the ecliptic. Its trace on the plane of the ecliptic drawn through the sun evidently intersects the earth's orbit at points which the earth reaches at the dates of the summer and winter solstices. In these projections less than one-half the visible hemisphere is illuminated between the autumnal equinox and the winter solstice.

The direction in which the eclipse of the moon will be seen, Fig. 2, is shown by the arrows. It will be visible at Washington, the beginning visible generally in North and South America, and northeastern Asia, the ending generally visible in North America, northwestern South America, eastern and northern Asia, and Australia.

In Fig. 3 the arrow shows the direction in which the eclipse of the sun will be seen. The limit of visibility will include a very small part of Australia New Zealand, Tasmania and the South Shetland Islands.



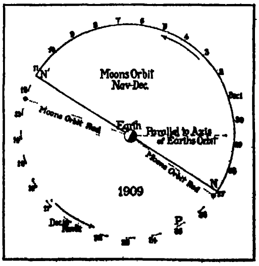
DIRECTION IN WHICH ECLIPSES WILL BE SEEN.

* * *

Why the Pole Shifts.

It is well established that, at least during historic times, no changes of any considerable magnitude have occurred in the latitudes of places on the earth. It has long been suspected by astronomers, however, that minute changes of latitude were taking place, but it *is only during the last quarter century that the methods* of observation and calculation have reached that degree of refinement necessary to detect these small changes.

In 1884 and 1885 Dr Küstner, astronomer at the Royal Observatory of Berlin, made a series of observations upon certain stars for the purpose of determining the constant of aberration—the maximum apparent displacement of a star due to the finite ratio between the speed of the earth in its orbit and the velocity of light. One of the quantities used in the reduction of these observations is the latitude of the place of observation. Dr. Küstner found his results to be discordant, much more so than he had good reason to believe that they should be from the known care and precision with which the observations were made. Upon investigation it was found that these discrepancies could be almost entirely explained away by assuming a change in the latitude. Dr. Küstner, therefore, in 1888, made the bold announcement that the latitude of the Berlin Observatory had changed during the period over which his observations extended.



ENLARGED PLOT OF MOON'S ORBIT.

This announcement aroused widespread interest, and steps were immediately taken by the International Geodetic Association to test the reality of the announced variation. Through the co-operation of the observatories at Berlin, Potsdam, Prague, and Strasburg, observations for latitude were begun in 1889 and carried on continuously over a year These observations agreed in showing a minute but appreciable change in the latitude. In order to test the matter still further, an expedition was sent in 1891-2 to Honolulu, and observations for latitude were made there simultaneously with others made at the observatories just named. As Honolulu is on the opposite side of the earth from Europe, it is seen at once that if the latitude were increasing at the European observatories, a corresponding decrease should be shown at the Honolulu station. The results came out as expected, and this was generally accepted as a complete demonstration of the reality of this phenomenon.

What is the cause of this wandering of the Pole? In an article by Dr Sidney Dean Townley of Stanford University, this explanation is given.

In 1765 Euler, a famous Swiss mathematician, demonstrated, as a proposition in dynamics, that if a free rigid oblate spheroid rotates about an axis which differs slightly from the axis of figure, or shortest axis, then the axis of figure will revolve about the axis of rotation in a period the length of which will depend upon several factors He computed that, if the assumed conditions obtained for the earth, then the period of revolution of the axis of figure above the axis of rotation would be 306 days. Obviously, however, the earth is not rigid, the oceans are quite plastic and the ground itself is possessed of some elasticity Prof. Newcomb computed some years ago that, if we assume the earth as a whole to possess the rigidity of steel, then the period of revolution of the one axis about the other would be 441 days, as against 306 days found by Euler on the assumption that the earth is perfectly rigid. The actual observed period is fourteen months, or 427 days, and the legitimate *conclusion to be* drawn is that the earth as a whole is somewhat more rigid than steel—a conclusion that agrees with that derived by Lord Kelvin and others from entirely different considerations.

Now the question arises, Why does the earth not rotate upon its shortest axis? The explanation is simple. If the earth ever did rotate upon its shortest axis it could not continue to do so because of the shifting of matter upon and within the surface. Winds, rains, rivers, and ocean currents are ceaselessly transporting matter from point to point, and during the winter great masses of snow and ice accumulate in the temperate and frigid zones only to disappear again in the summer Although these effects will, to a large extent, neutralise each other, the sum total can not be other than to produce at least a theoretical lop-sidedness to the earth; and as soon as this takes place there must be a shifting of the axis of rotation. The time of revolution of the one axis about the other could be accurately computed if the exact form of the earth, the structure of the earth's interior, and its coefficient of elasticity were known.

In addition, there are other phenomena, namely, volcanoes and earthquakes, through which considerable quantities of matter may be displaced. That the amplitude of the polar motion might be affected by earthquakes was pointed out by Prof. Milne ten or fifteen years ago and a French scientist has more recently compiled a table showing the number of severe earthquakes each year and the amplitude of the polar displacement. A rough proportionality between the two seems to exist; that is, the greater the number of earthquakes each year, the greater the amplitude of the polar displacement. Such results, however, are to be taken with several grains of allowance. The term "severe earthquakes" is rather indefinite and by modifying the definition quite a variety of results may be obtained from the given data. It should be pointed out that in 1906, the year of the great earthquakes in California and Chile, the amplitude of the polar displacement was small.

We have then a rational [illegible] [illegible] [illegible]

[illegible] according to the [illegible] the axis of figure must revolve around the axis of rotation, giving rise to the changes of latitude. But on account of the changes incessantly taking place in the distribution of matter upon the earth's surface, and perhaps also within the surface, the amplitude of the polar displacement, and perhaps the principal period of revolution of the one axis about the other, are changeable, the changes taking place in an undetermined way.

In connection with this explanation we should not lose sight of the fact that all the material moved through meteorological, volcanic, and seismic agencies is probably almost infinitesimal as compared with the total mass of the earth, and no one has as yet shown that the shifting masses are sufficient in magnitude to account properly for the observed annual and other unexplained components of the polar motion.—Abstracted from the Popular Science Monthly

An International Sport Exposition.

An exposition devoted to sports and games is to be held in Frankfort-on-the-Main in 1910 Frankfort is annually the scene of many sporting contests, for which reason the selection of the city for the purpose of an international exposition is certainly wise. An executive committee has been formed the first task of which was to give the organization its name, which rings imposingly "Verein Internationale Ausstellung fuer Sport und Spiel." The exposition will be divided into the following groups 1 Horses and vehicles (harness, riding and driving equipment, stables, horse breeding and care) 2. Automobiles and motor-driven vehicles. 3 Turf sports, such as gymnastics, fencing, open-air athletics (tennis, football, golf, handball, polo, cricket, gymnastic apparatus, weapons, etc.) 4 Aquatic sports (rowboats, sailboats, motor boats, swimming, and fishing) 5. Winter and Alpine sports (skates, skis, snowshoes, sleds, huts, climbing outfits) 6. Hunting (guns, sportsmen's apparatus, stuffed animals) 7 Aerial sports (free balloons, dirigible airships, flying machines, models, aeronautic instruments) 8 Tourists' exhibits, such as photographic and optical apparatus (charts, guide books, history and literature of traveling, telescopes, etc) 9 Application of sport to therapeutics (gymnastic apparatus, life-saving devices transportation of invalids) 10 Sporting outfits of all kinds 11 The artistic side of sport. 12. Toys. 13. Miscellaneous.

Award of a Medal for the Discovery of Bakelite.

At the second regular session of the New York Section of the American Chemical Society, held at the Chemists' Club, 108 West 55th Street in this city, on the evening of November 5th, Dr Leo H. Baekeland, president of the Electro-Chemical Society, was awarded and presented with the Nichols medal for his papers on "The Synthesis, Constitution, and Industrial Application of Bakelite" and "Soluble and Fusible Resinous Condensation Products of Formaldehyde and Phenol."

In accepting the medal Dr Baekeland expressed his thanks for this expression of regard for his work, and alluded feelingly to the friendly co-operation and aid he had received from the fellow members of the section He then exhibited several industrial applications of the new compound bakelite, and made an experimental comparison of the resiliency of a ball of bakelite the size of a billiard ball with an ivory billiard ball A stand three feet high was set upon the lecture table. The ivory ball was then dropped from the upper side of the stand to the table, the height of its rebound was noted, and the length of time of the rebound until it came to rest, which was six seconds, by the use of a stop watch. The ball of bakelite passing through the same height to the table rebounded at least six inches higher and came to rest in ten seconds, showing much greater resiliency than ivory

Bakelite is used very successfully in the manufacture of electro-magnet spools, and is claimed to be superior to gutta percha in that it will stand a greater degree of heat, in the event of a short circuit.

The Current Supplement.

The opening article in the current SUPPLEMENT, No 1768, deals with Henry Farman's new biplane. An excellent picture of the machine with Farman seated in it is presented. The first installment of an article on bakelite, a new composition, is given by L. H Baekeland, its inventor. Samuel K. Patteson writes instructively on the measurement of humidity The relation of Charles Darwin to Mendelism is set forth by Dr. A. E. Shipley. Recent models of superheated steam locomotives are described and illustrated. An illustrated description of the fast turbine yacht "Winchester" is published. Major H. L. Hawthorne critically points out the advantages and defects of balloons and airships in war. [illegible] concludes his article on the making of automobile tires. [illegible] [illegible]

Correspondence.

FIGHTING POWER OF THE "INFLEXIBLE."

To the Editor of the SCIENTIFIC AMERICAN

May I call the attention of your correspondent, Emerson B. Manley, whose letter appeared in your issue of October 23rd, to the fact that the "Inflexible" is not a sister ship of the "Dreadnought"? The "Inflexible," despite the number and power of her guns, is not rated as a battleship, but belongs to the cruiser class.

In an engagement between such a ship and a battleship carrying four 12-inch guns and a powerful secondary battery of 8's and 7's, it is most improbable that the ship of the "Inflexible" type would engage—and her excessive speed would give her the range decision—at such a range that her enemy's secondary battery could be effective Her preponderance in big gun power—eight 12's against four—would enable her to demolish the secondary battery before the 8-inch and 7 inch guns could get a single effective shot home.

M LATOUCHE THOMPSON

St. John's Rectory Manitou, Man

WHY WATCH SPRINGS BREAK.

To the Editor of the SCIENTIFIC AMERICAN

Being an old subscriber to your most valuable paper, I take the liberty of writing you regarding the unusual, or I should say peculiar, action of main springs in watches. My father, an horologist of over fifty years, and I, who learned the trade from him, have had some, as we think, remarkable experiences in the main-spring line We think climate has much to do with their breakage, but if a watchmaker with sweaty hands handles a spring, there will be trouble Also one who uses gasoline or any of the similar fluids will have the same trouble.

Our trouble has been mostly in the season when electric storms prevail, or a sudden change of temperature. We always advise our customers not to put watches on a marble dresser or any cold surface, but leave them in their pocket. The temperature in the vest or other garment changes gradually, and thus does away with any sudden expansion or contraction We have been in the Mississippi Valley for many years, and our experience has been that, specially during the fall and spring seasons, during thunder storms we have more trouble with main springs. Sweaty hands do no good to a main spring Tissue paper, in our experience is the proper thing to wipe a spring with May be slightly oiled. My father has been very successful in that line of watch repairing

Natchez, Miss F T BESSAC M O

RAILWAY MOTOR CARS.

To the Editor of the SCIENTIFIC AMERICAN

In your last issue I notice that you are to have a special issue on the middle West. I wish you would call attention through your valuable magazine to the need of some kind of a motor car that will run on railway tracks. It should be an independent motor car, run by its own engines. There is an opening for thousands of miles of so-called interurban railways in Iowa and other middle West States, where it would not pay to build an electric railway line on account of the large expense, but if some economical and reliable form of independent motor car could be perfected, such cars could be used for passenger traffic, and small steam locomotives for freight cars and such roads would pay well The track should be built on modern lines, with easy grades and curves and independent right of way, so that trains and cars can make good time for passenger service and can also handle freight cheaply, by use of regular freight cars from the steam roads, and thus would be valuable feeders and distributers for the steam roads, where branch steam lines would hardly pay Such motor cars for passenger service should also be used on many branch steam railway lines, where better passenger service is badly needed, and where steam passenger trains are too expensive to run often enough to give good service

Motor cars of this sort to use gasoline for power have been perfected and are in use in several places but they are gradually being abandoned on account of the constantly increasing cost of gasoline It seems that little or no progress is being made in perfecting such motor cars to use alcohol or kerosene. Might not the producer-gas engines for small boats requiring less than 500 horse-power be adapted for these motor cars? In your issue of September 18th 1909, on page 191, you made mention of a very remarkable demonstration of the possibilities of producer-gas engines of this sort by Mr H L. Aldrich, using pea-anthracite, which at a cost of $4 per ton is stated to be one-tenth the cost of operation of a gasoline engine with gasoline at 15 cents a gallon, to produce equivalent power

For a long time it has seemed to me that there is an excellent opportunity for invention in the production of such an independent motor car, operated by some power other than gasoline. Some cars of this sort are in apparently successful operation which generate electric power by means of a gasoline engine, but it seems that in so roundabout a system, there must be a large waste of power

Equipped with motor cars of the sort suggested, such railways could be built much cheaper than trolley lines, and also operated much cheaper, until the business grows to a point where it would pay to change to electric power The perfecting of such a car would mean the building of many miles of new railways, and possibly the cars would also be adopted in time by the steam railways to give better local passenger service. Many good towns in Iowa are made "whistling stations" by the steam roads in their mad race for through business

Lack of better railway facilities, and lack of many miles of new railways that should have been built long ago, are factors that are holding back the development of a great deal of this middle West country

Steam railways want through business, long hauls, and great tonnage, electric railways are too expensive as yet in many places If a motor car that is light, reliable and not expensive to operate can be perfected using producer gas engines there is no question but that there is a great opportunity and opening for such a car, as above suggested

I trust that you will deem this communication as important as the number of our ancestors, for instance.

Belle Plaine, Iowa. H R MOSNAT

ANOTHER EVIL OF DEFORESTATION

To the Editor of the SCIENTIFIC AMERICAN

One of the recognized evils produced by the woodmen who spare no tree (but leave where once the lord of the forest stood, the earth all bleak and bare) is the reduction in the yield of water power But it seems that the fact that deforestation also increases the cost of what water power you do get, has never been mentioned

Suppose that the flood level of a normal river is such as to require a 25 foot dam for power purposes. After the valley has been skinned of its foliage the flood level will be so much greater that a dam 30 feet or more in height will be necessary

As the cost of dams increases with the squares of the heights (because the higher up the thicker), the 30-foot dam will cost nearly fifty per cent more than the 25 foot and yet it will yield less power than the 25-foot would yield in the normal river because deforestation has diminished the flow of water in the dry season

The yield in the dry season is the available yield, because the larger yield at other seasons is of little value for almost all users of power want power all the year around

It is true as I showed in my article in Cassier's Magazine of September 1909 that if we would use both turbines and current motors in the same dam, high dams would not be necessary in many rivers, but this truth may be disregarded because it will probably be a hundred years before the system there mentioned will meet the right man the man who will introduce it.

SYLVESTER STEWART

Brooklyn, N Y

The Death of Theodore R. Timby

Theodore R Timby died on November 9th 1909 at Brooklyn, N Y He was chiefly known because of his claim to having invented the revolving turret of the famous Monitor" and that accordingly, he should have received the fame history accorded to John Ericsson For more than forty years he had tried to collect $500 000 from the United States for two inventions, one the revolving turret on warships and the other a device that points and fires heavy guns with electricity Other things which Timby invented, and from which he obtained both recognition and financial reward, were a floating drydock a system of coast defense, and a turbine wheel which proved especially successful

A Book of Fourth-Dimension Essays.

The subject of the fourth dimension seems to have aroused so much interest among the readers of the SCIENTIFIC AMERICAN that we have decided to publish in book form the prize essay the three essays that received honorable mention and about sixteen of the best essays which were submitted in the recent Fourth Dimension Contest The entire collection will be edited by Prof H P Manning who will prepare an introduction of considerable length in which the subject of the fourth dimension will be simply and lucidly discussed The book will be ready about the latter part of December

The meeting of the British Association in Winnipeg on August 25th is the third which has been held in the Dominion The first Canadian meeting took place in 1884 at Montreal, the second thirteen years later at Toronto The fact that the third was held at Winnipeg may be regarded as significant of the enormous development of the West during the past few years.

HOW LEMON OIL IS MADE.

BY FRANK N BAUMERT

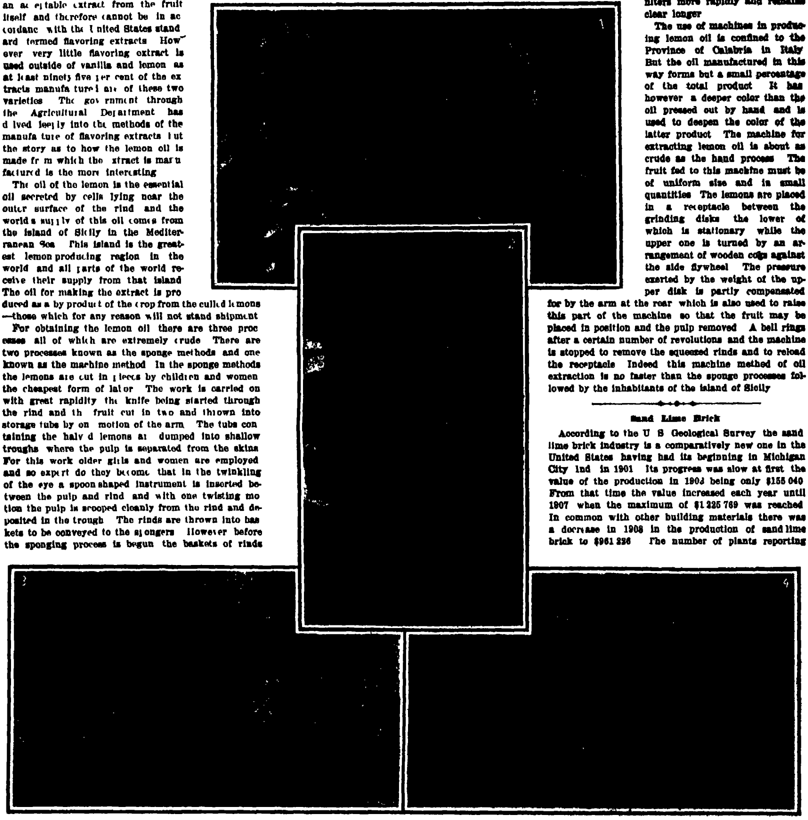
We all know that the flavoring extracts used in this country are of domestic manufacture and that the two principal flavors are vanilla and lemon but few have a knowledge of what actually constitutes these extracts To quote from the standards laid down by the United States Department of Agriculture a flavoring extract is a solution in ethyl alcohol of proper strength of the sapid and odorous principles derived from an aromatic plant or parts of the plant with or without its coloring matter and conforms in name to the plant used in its preparation Peach strawberry pineapple and some other flavoring extracts are always artificial it being impossible to make an acceptable extract from the fruit itself and therefore cannot be in accordance with the United States standard termed flavoring extracts However very little flavoring extract is used outside of vanilla and lemon as at least ninety five per cent of the extracts manufactured are of these two varieties The government through the Agricultural Department has delved deeply into the methods of the manufacture of flavoring extracts but the story as to how the lemon oil is made from which the extract is manufactured is the more interesting

The oil of the lemon is the essential oil secreted by cells lying near the outer surface of the rind and the world's supply of this oil comes from the island of Sicily in the Mediterranean Sea This island is the greatest lemon producing region in the world and all parts of the world receive their supply from that island The oil for making the extract is produced as a by product of the crop from the culled lemons—those which for any reason will not stand shipment

For obtaining the lemon oil there are three processes all of which are extremely crude There are two processes known as the sponge methods and one known as the machine method In the sponge methods the lemons are cut in pieces by children and women the cheapest form of labor The work is carried on with great rapidity the knife being started through the rind and the fruit cut in two and thrown into storage tubs by one motion of the arm The tubs containing the halved lemons are dumped into shallow troughs where the pulp is separated from the skins For this work older girls and women are employed and so expert do they become that in the twinkling of the eye a spoon shaped instrument is inserted between the pulp and rind and with one twisting motion the pulp is scooped cleanly from the rind and deposited in the trough The rinds are thrown into baskets to be conveyed to the spongers However before the sponging process is begun the baskets of rinds are immersed in water for four or five hours The work of extracting the oil is done entirely by men as the task is quite a laborious one These workers sit upon low stools the skins being dumped upon the floor near them and a basket for the exhausted skins set in a convenient place A small earthenware bowl is placed on the floor between the workman's knees This bowl has at one side a lip directly beneath which is a concave depression which serves to hold back the residue when the oil is poured from it Across the top of the bowl is placed a round stick about one inch in diameter notched to fit the widest part of the vessel. Across this stick is hung a flat sponge surmounted by another thicker one and finally a third, which is cup-shaped into which the lemon rind is inserted with one hand the other being used to press the sponge, the weight of the whole body being thrown into the motion The lemon skin is then turned partly over and the pressure renewed Each half rind is handled separately receiving three or four pressings It requires about two thousand of these half rinds to produce one pound of oil, the exact quantity depending upon the size ripeness and freshness of the lemons The green fruits produce more oil than the ripe A good workman can squeeze out two or three pounds of oil a day for which he receives about fifty cents This oil is worth in quantities about one dollar a pound But for making lemon extract, but a small portion is required The method of manufacture is simple The oil is dissolved in strong alcohol in the proportion of five parts oil and ninety five parts alcohol it is then filtered and bottled An idea of the small proportion of the oil required may be had when it is considered that five barrels of the oil and ninety five barrels of alcohol would make just one hundred barrels of pure lemon extract.

By the two-piece method only a small quantity of water is expressed with the oil and the process of separation is very simple, the bowl being tilted forward until the oil can be blown from the surface over its edge into another receptacle. The water and residue remaining are separated from the traces of oil by the same means, and finally filtered through felt bags The residue left in these bags is collected for several days, when the bags are placed under a hand press and freed from the last traces of oil. What is known as the three-piece method differs from the one just described mainly in the preparation of the skins before pressing The rind of the fruit is pared off in three slices, leaving the greater part of the pulp with some little skin at the ends. This paring, as a rule, is done by boys or men, and the skins are washed and soaked as in the two-piece process. Much more pulp is left adhering to the skins in the three-piece method, and naturally more juice is mingled with the oil than by the other method The claim is made, however that oil made in this way filters more rapidly and remains clear longer

The use of machines in producing lemon oil is confined to the Province of Calabria in Italy But the oil manufactured in this way forms but a small percentage of the total product It has however a deeper color than the oil pressed out by hand and is used to deepen the color of the latter product The machine for extracting lemon oil is about as crude as the hand process The fruit fed to this machine must be of uniform size and in small quantities The lemons are placed in a receptacle between the grinding disks the lower of which is stationary while the upper one is turned by an arrangement of wooden cogs against the side flywheel The pressure exerted by the weight of the upper disk is partly compensated for by the arm at the rear which is also used to raise this part of the machine so that the fruit may be placed in position and the pulp removed A bell rings after a certain number of revolutions and the machine is stopped to remove the squeezed rinds and to reload the receptacle Indeed this machine method of oil extraction is no faster than the sponge processes followed by the inhabitants of the island of Sicily



1 Two-piece method of extracting the oil 2 A Calabrian lemon-oil machine 3 Interior of Sicilian lemon-oil factory. 4. Removing the pulp of the fruit.

HOW LEMON OIL IS MADE.

◆

Sand Lime Brick

According to the U S Geological Survey the sand lime brick industry is a comparatively new one in the United States having had its beginning in Michigan City Ind in 1901 Its progress was slow at first the value of the production in 1903 being only $155 040 From that time the value increased each year until 1907 when the maximum of $1 225 769 was reached In common with other building materials there was a decrease in 1908 in the production of sand lime brick to $961 226 The number of plants reporting made a rapid growth from 16 in 1903 to 94 in 1907, with a slight decrease in 1908 (to 87)

Common front, and fancy brick were manufactured from sand and lime in 1908 The average price per 1 000 for common brick was $6 63 as against $6.61 in 1907 and $6 71 in 1906 for front brick the price was $12 16, against $10 96 in 1907 and $10 48 in 1906. In 1908 common brick composed 82.57 per cent of the value of all bricks, and front brick 15 37 per cent.

Thirty States reported both in 1907 and 1908, Alabama dropping out of the list in 1908 and Montana appearing Of the individual States Michigan, as in 1907, was the leading State in 1908, reporting brick valued at $[illegible]. Florida was [illegible]

ARTILLERY FOR AIRSHIP ATTACK.

BY OUR BERLIN CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

After having carefully studied the problem which is presented by the conditions of firing at great heights and at a large angle such as is required for use with airships, aeroplanes or balloons, the Krupp firm has brought out three general types of cannon each of which is adapted for a special use. In the first place we have the more simple type of cannon with field mounting, while a second type is constructed with a view of being placed upon a motor car For use on shipboard they design a third type which is represented in our engraving In the second and third cases the cannon is designed to be rapidly rotated in all directions by the use of a central pivot base such as is usually installed on vessels and for coast defense use On the other hand the field gun has its wheels arranged so as to turn upon pivots which allows of placing the wheels in the crosswise direction in the position here shown In order to give effective results it is found that the angle of elevation must be at least 70 degrees and the field gun is designed to reach this angle The automobile and ship cannon will however make a greater angle the maximum being for these two types as high as 75 degrees In all these cases a rapid rate of firing is given by an automatic opening and closing of the breech The caliber has been reduced as much as possible as also the weight of the projectile while the long bore gives a high initial speed to the shot and diminishes the time required to attain the mark. Owing to the lessening of the caliber greater lightness is obtained and this is of service especially in the field and the automobile types of gun

Sighting is carried out in the most efficient manner by the use of an appropriate form of sighting telescope in combination with a general finder which covers a wider range of field There is also a range-finder by which the distance is first obtained and afterward the indications are directly given so as to be able to point the gun for different heights of the airship without loss of time and thus the use of firing tables is dispensed with in all these cases

The question of the kind of shot which is best adapted for firing upon balloons or airships is of prime importance and this matter has been made the object of a number of experiments It is recognised that shrapnel will penetrate the balloon envelope but without doing much damage at least of an immediate nature seeing that the holes are closed again for the most part by the internal pressure of the gas so that the loss of gas is not a rapid one and the airship is able to reach a place of safety in the majority of cases It is found that the most effective form of projectile is a special kind of grenade which is designed to explode in the interior of the balloon and to bring about ignition of the gas The new projectile designed by the Krupp firm is intended to accomplish this and at the same time the path of the projectile from the time it leaves the gun can be followed by the use of a special smoke producer carried on the shot. By observing the trail of smoke the gunner learns whether the shot comes near the mark When the projectile leaves the gun the smoke producer has been set working by an appropriate device At night the path of the shot is still followed by the light which the smoke producer gives out. When it penetrates the envelope a very sensitive device causes the detonation of the grenade.

The 4 2-inch Krupp gun for aeronautic attack, on a naval mount

In the case of the field cannon which has a 6 5 centimeter bore (2 6 inches the weight of the gun itself is 775 pounds and that of the chassis 1 1[illegible]0 pounds making a total of 19[illegible]5 pounds for the cannon when prepared for actual service The gun can be turned about through a complete circle and has a maximum vertical angle of 70 degrees The weight of the projectile for this type is 9 pounds The initial speed of the shot is 2 050 feet per second With the field gun it is possible to cover a maximum range of [illegible]8 [illegible]0 feet and a maximum height of 18 800 feet

Of a heavier build than the former and also of greater range is the second type of gun of 7 5 centimeter (3 inch) caliber which is designed to be mounted upon a heavy motor car as we represent it in our engraving Like the former it is provided with hydraulic recoil brake and in the present case there is used a middle pivot For elevating and lowering the gun through the required range there is used a double-toothed sector which is driven by pinion and crank A special arrangement is used for the rotation by which a slow movement is obtained but a quick rotation may also be given by a more rapid mechanism when it is needed to turn the gun rapidly into any desired position It is to be noted that owing to the high speed at which the airships move such quick movements are one of the features which need to be especially designed in the case of guns for balloon firing The weight of the gun itself or 990 pounds combined with the weight of the support 1 550 pounds gives a total weight of [illegible]540 pounds for this type of gun We have here the maximum angle which is reached in the Krupp cannon or 75 degrees The weight of the projectile is 12 pounds and the initial speed [illegible]060 feet per second The maximum range is about 30 000 feet and the greatest height about 20 000 feet As regards the automobile car which is designed to take the present cannon its total weight (exclusive of the gun) is 3 ½ tons and it has an average speed of 30 miles an hour

Owing to the fact that both axles are driving axles with the use of the 50-horse power motor the automobile car is able to travel over very difficult ground and it easily mounts very steep grades Under the front seat is a roomy chest which holds a good supply of tools and extra fittings and special attention has been given to this point so that the car will not easily become disabled To make the platform of the car as steady as possible during the firing the platform

(Concluded on page 383)

Bore, 2.6 inches; projectile 9 pounds; velocity 2050 f s. maximum range, 28,550 feet.

Field gun for airship attack.

Destruction of a captive balloon by a special form of incendiary grenade.

The 3-inch 12-pounder Krupp field piece for airship attack The weapon can be brought to a maximum elevation of 75 degrees The motor car on which it is mounted is of 50 horse-power and has an average speed of 30 miles an hour

The projectile emits a train of smoke which marks the path of its flight

ARTILLERY FOR AIRSHIP ATTACK.

WIRELESS COMMUNICATION WITH BALLOONS.

On May 13th, 1908, an ascension was made with the United States Army Signal Corps balloon No. 10 with Lieut.-Col F P Lahm, Major E. Russel, and Capt. E S Wallace as passengers. Major Russel assisted by Capt F S Wallace made some wireless telegraph experiments in this connection.

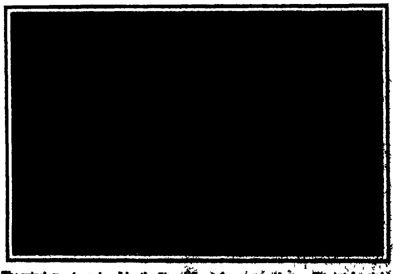
The basket of the balloon, which is about five feet long four feet wide, and three feet high, was surrounded on three sides by light galvanized wire netting about two and a half feet wide the surface being about thirty square feet When the balloon had ascended to a height of about one thousand feet, a flexible phosphor bronze wire three hundred feet long, such as is used in our army was paid out from the net of the basket not occupied by the wire netting The wireless receiving set consisted of a tuning device and small condenser similar to that used in the field wireless set connected with a silicon detector A Sullivan telephone receiver was used

The Washington navy yard station and the Annapolis station agreed to begin sending signals every fifteen minutes for five minutes each The Washington station began at 1 45 and the Annapolis station at 2 30 o'clock This sending was to be kept up until 3 30 o'clock Signals were immediately picked up from the Washington station although not very clearly, and the reception of signals continued until the balloon was about six miles away, when the Washington station could no longer be heard It was learned that the Washington station was being overhauled, and that only one of their small sets was used Signals from the Annapolis station were picked up easily as soon as the sending began, these signals coming in so loudly and clearly that it would seem as if the excellence of this means of receiving would be all but equal to that of the land station During each of the sending periods after this until 3 30 o'clock the Annapolis signals came in clearly the distance from that station varying about twenty miles at the beginning to ten miles at the close No disturbance from atmospheric electricity was apparent although the vertical antenna was several times left disconnected for some little period, in order to see if any spark could be obtained between it and the netting. No spark could be detected

It is believed by the army officers who made the experiments that this extension of the use of wireless telegraphy may prove of considerable value in extending the usefulness of an aerial reconnaissance. It may be regarded as certain that at least over distances no greater than were worked at this time, a sending set could have been utilized It will be necessary, of course to provide some means of masking all of the apparatus which might produce hot sparks, and it is probable that a special means of preventing the gas from pouring from above should also be provided

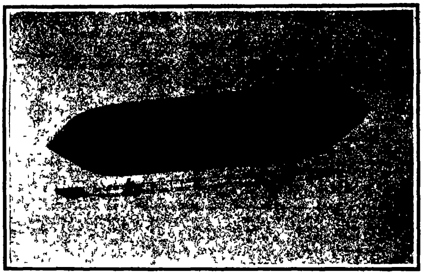
The photographs herewith presented show a sending and receiving outfit that has been prepared for the War Department for use on a balloon, but there is no record describing this apparatus or describing any contemplated use thereof Since the apparatus was designed for aeronautic purposes it seems not unlikely that it may be used with the Baldwin dirigible.

Detail view of the aerial wireless set. Note the masked spark gap in the upper right-hand corner of the frame.



The wireless set employed by the Signal Corps for aeronautic use. The total weight is about 70 lbs. An 8-volt, 20-lb. accumulator supplies the current.

WIRELESS COMMUNICATION WITH BALLOONS.



U. S Army dirigible No. 1 (Baldwin type) with which wireless experiments may possibly be conducted.

Aeroplane Flights in America.

The efforts of the numerous experimenters in the United States and Canada are beginning to show results in the form of short flights by a number of embryo aviators just at the time when public interest in flying machines is becoming sufficiently great to cause the organizing of aviation meetings with liberal prizes, such as have been held in Italy, Germany, and England recently with the Rheims meeting in France as a model. The first such meeting in America to have more than one aeroplane make flights occurred last week at the Latonia race track at Cincinnati, Ohio. Besides flights by Glenn H. Curtiss, Charles F Willard also made a number of successful flights with the biplane of the Aeronautic Society, which is the first aeroplane Mr Curtiss built for sale. When Mr Curtiss damaged his machine by hitting a wagon in alighting, the spectators were not obliged to leave disappointed, since Willard made some excellent flights. Roy Knabenshue, Lincoln Beachy, and Cromwell Dixon, the 17-year-old aeronaut, all made excellent flights in their dirigibles, and the three-day meet was a decided success.

Encouraged by the success of Mr F Raiche in getting his small biplane off the ground at Morris Park some time ago, a number of other members of the Aeronautic Society have been actively engaged in completing their machines. The second biplane to make several short flights there was that of P Brauner and A J Smith In the morning of October 31st Mr Brauner flew about 350 feet at a height of 8 feet, and in the afternoon Dr Green made a flight of some 250 feet. The following day, after getting off the ground once, Mr Brauner, in a second attempt, sent the machine aloft too suddenly, with the result that it lost headway, dropped backward to the ground, and was smashed The aviator pitched forward but was not hurt. Using the same motor—a 25-horse-power A. & B. 4-cylinder water-cooled engine of 260 pounds weight—upon his biplane, Dr William C. Green got off the ground and made six flights of from 30 to 100 feet in length at Morris Park on the 12th instant. The last flight was made at dusk, and a wheel was broken in alighting Both of these biplanes resemble the Curtiss in design, having balancing planes and a single propeller on the engine shaft back of the main planes. They are both larger machines than the Curtiss biplane, however, [illegible]

Another aeroplanist who has [illegible] and made flights of several hundred feet [illegible] Frank Van Anden, of Islip, L. I. Mr. Van Anden's biplane is a very light machine, weighing complete with a 15-horse-power motor but little more than [illegible] pounds.

At the Petawawa military camp in Canada, J. A. D. McCurdy also made a number of excellent flights recently with his new "Baddeck No. 2" biplane. This new machine, which was constructed after the "No. 1" was demolished in an accident, has shown excellent speed and stability. It is fitted with a relatively heavy 4-cylinder water-cooled motor having a single propeller on its crankshaft. In general design it is like Curtiss's, being, like his, the outcome of the experiments of the Aerial Experiment Association. Mr. McCurdy had hoped to take his machine to England and fly there for the $5,000 prize of the Daily Mail offered for the first mile flight in a circle by a British-built aeroplane piloted by a British aviator Capt. Cody, the American who has been experimenting in aeronautics for some time past for the English army, recently became naturalized so as to compete for this prize with his aeroplane. But both aviators have lost this opportunity, since Mr. J C. Moore-Brabazon, a well-known English sportsman, has lately won the prize with a machine resembling the Wright, but having peculiar balancing planes between the main planes at their ends instead of warping the latter.

* * *

Gasoline vs. Alcohol.

A gallon of denatured alcohol can be made to do the same amount of work in an engine as a gallon of gasoline; moreover, the alcohol does not produce smoke and is less liable to yield obnoxious odors, but the lower price of gasoline makes it the cheaper fuel. These conclusions, based on the results of 2,000 comparative tests of the two substances as engine fuels, are given in Bulletin 392 of the United States Geological Survey R. M. Strong, the author of the bulletin, briefly describes the tests but discusses the more important results at some length. The tests formed part of the investigation of fuels now being carried on by the Survey To determine the relative efficiency and economy of gasoline it was compared with denatured alcohol. In this comparison not only the heating values of the two fuels but their adaptability to engine use and the effects of variations in fuel quality and in the principal operating conditions—such as load, fuel supply, and time of ignition—were carefully studied. Tests were made with gasoline and alcohol in the same engine and repeated in other engines of approximately the same size (10 and 15 horse-power) and the same piston speed, with different degrees of compression, different methods of governing, and different [illegible]

* * *

If most Americans were asked which is the highest mountain in the United States, they [illegible] answer Mount Rainier. As a [illegible] belongs to Mount Whitney, which [illegible] in height by less than 100 feet. [illegible] Mount Rainier is 14,363 feet [illegible] that of Mount Whitney, by [illegible] feet above mean sea level.

THE WELLCOME TROPICAL RESEARCH LABORATORIES.

[illegible]

[illegible] years ago the whole of the Sudan was a closed book to the outside world, being under the sway of fanatic barbaric Mahdism. To-day it is a country of increasing prosperity, and at the ancient capital of the Dervishes has been erected a magnificent pile of educational buildings, the Khartum College, a section of which comprises an extensive and elaborately equipped tropical research laboratory. When the country was finally subdued, it was realized that the peculiar conditions prevailing, both climatic and geographical, rendered the territory a difficult one for the residence of the white man. It was the home of innumerable and mysterious diseases and infectious maladies, which rendered it untenable to the white man, and were also destructive among the ranks of the natives. Moreover, these maladies were peculiarly endemic to the country, and it was realised that the only possible method of reclaiming it for civilisation was the investigation and solving of these problems upon the spot, by the most up-to-date scientific methods possible.

Scarcely had the last shots in the campaign been fired, when a movement was started for the foundation of an educational college on the site of the Mahdi's stronghold. Here it was decided to study the questions upon a small scale at first. Owing to the generous munificence of a well-known Englishman, Mr Henry S. Wellcome, however, it was found possible to establish an extensive institution for tropical research. The donor, in connection with his gift to the Sudanese government, offered to equip the laboratories with all the latest appliances that might be desired, so that the investigations could be carried out upon the most comprehensive lines. These laboratories are unique, inasmuch as they are the only ones of their character upon the African continent, which is unanimously held to be the greatest seat of all those peculiar natural conditions inimical to the white man which have appreciably retarded the development of the country in the past. But through the efforts of this institution invaluable work has been accomplished in reclaiming the northern part of the country, which, in conjunction with that of the Liverpool and London Tropical Schools of Medicine, has assisted in the hygienic betterment of the continent at large.

The work of the Wellcome Tropical Research Laboratories is broadly divided into six ramifications, as follows: (1) The promotion of technical education, (2) the bacteriological and physiological study of tropical disorders, more especially the infectious diseases of both man and beast peculiar to the Sudan, and to extend assistance to the officers of health and to the clinics of the civil and military hospitals, (3) to assist experimental investigations in poisoning cases, by the detection and experimental determination of toxic agents, particularly the obscure potent substances employed by the natives; (4) chemical and bacteriological tests in connection with water, food-stuffs, and such sanitary matters as may be found desirable, (5) the promotion of the study of disorders and pests which attack food and textile producing and other economic plant life in the Sudan, (6) to undertake the testing and assaying of agricultural, mineral, and other substances of practical interest in the industrial development of the Sudan

The floating laboratory on the Nile, auxiliary to the Wellcome Research Laboratories.

Part of bacteriological section of floating laboratory.

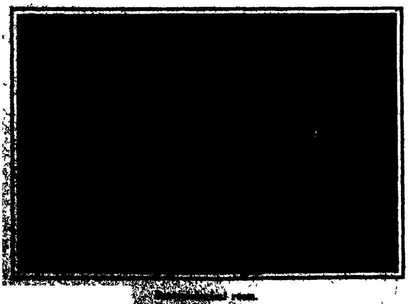
The work upon these diverse subjects is under the direction of Dr Andrew Balfour, B Sc D P H F.R. C P, and he is gladly assisted by the various other departments of the government which are interested in one or more of the avowed objects of the Institution such as the Egyptian Army Medical and Veterinary services, indeed, the co-operation of outside workers in the same field is much appreciated and fostered so that there may be an indisputable conclusiveness concerning the results achieved Within the first year of its foundation the laboratories became fully occupied in all their departments, and then Dr Andrew Balfour gradually and carefully selected the best fields of work, and concentrated the attention of his staff thereon Chemistry and entomology have received almost as much attention as tropical medicine, and recently the work of the Institution has been extended to the sciences of ethnology, ethnography, and anthropology

Tropical medicine comprises researches in the trypanosomiasis of animals, chiefly cattle and camels—fortunately the dreaded scourge of sleeping sickness among humans has not extended to the Sudan. Piroplasmosis, spirochætosis of Sudan fowls, and studies of the many fell diseases such as kala-azar mycetoma, and dengue fever which cripple human life in the tropics constitute the most prominent of the purely pathological and bacteriological work Then again the sanitary organization of Khartum and Omdurman has been taken in hand involving the destruction of mosquitoes and the introduction of sanitary laws and a conservancy service. Dr Balfour the director is the medical officer of health of the towns and with the adequate laboratory resources at his disposal has been able to revolutionize completely the conditions of life in a few years, and has practically exterminated malaria at Khartum

The headquarters of the laboratories are at the Gordon College, and here within a period of seven years innumerable experiments and investigations were carried to a successful issue and a mass of unique information collected which is of inestimable value in connection with the subjects treated It was found however that the conditions under which the researches were made were not quite perfect, on account of the possibility of change in or damage to bacteriological and other specimens in their transmission from remote districts to Khartum It was therefore decided to carry the war into the enemy's camp and to carry out the investigations on the spot under conditions very similar to those at the Gordon College For this purpose a floating laboratory was established and the work accomplished therewith has been of far reaching value The southern Sudan is a country criss-crossed by waterways on the banks of which are clustered native villages wherein all manner of rare and interesting pathological conditions are to be found Flies and mosquitoes abound the birds reptiles and fish harbor strange parasites men die from curious diseases and there is a vast field for the study of tropical medicine Before the days of the floating laboratory, material occasionally reached Khartum from these distant territories but too often it was in a badly damaged condition Blood slides were dirty and spoiled insects broken and notes incomplete On the whole it was recognized that the proper study of conditions must be conducted on the spot and then many valuable data could be gathered

The floating laboratory is a commodious vessel well adapted to service upon the waters of the South The main working room is completely mosquito proof and is adequately fitted out for proto-zoological and entomological work Its maiden voyage was carried out

(Continued on page 381)



[illegible] room.

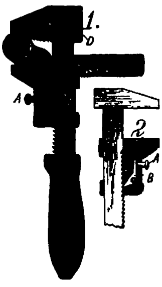
General chemical laboratory.

THE WELLCOME TROPICAL RESEARCH LABORATORIES AT KHARTUM

Patent Department

COMBINED PIPE WRENCH AND MONKEY WRENCH

The wrench illustrated herewith differs materially from the ordinary in the fact that the usual screw mechanism is entirely dispensed with and the jaws may be instantly opened or closed to any desired extent The wrench is also provided with a removable jaw piece which may be quickly applied to adapt it for use in gripping pipe or round work Fig 1 illustrates the wrench with the pipe gripping attachment applied thereon while Fig 2 shows the wrench adapted for ordinary use In this view the lower jaw is cut away to show the interior details It will be observed that the ratchet mechanism with which this wrench is equipped in place of the screw mechanism is controlled by a button *A* that projects from the forward face of the lower jaw When the button *A* is depressed the dog *B* is disengaged from the ratchet teeth permitting the jaw to be moved downward on the shank of the wrench A spring *C* serves to hold the dog in engagement with the ratchet teeth when the button *A* is released It is not necessary to operate the button *A* when closing the jaws on a piece of work but merely when it is desired to open them The pipe gripping device consists of a slotted member which may be fitted over the shank of the tool and is provided with inwardly inclined teeth as shown in the illustration The inventor of this improved wrench is Mr Charles Waller of Hamilton Wash



COMBINED PIPE WRENCH AND MONKEY WRENCH

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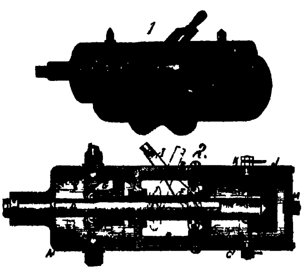
COMBINED TIMER AND DISTRIBUTER FOR INTERNAL COMBUSTION ENGINES

The speed of an internal combustion engine is commonly regulated by varying the time of the spark with respect to the position of the piston In the case of a multiple-cylinder engine the casing of the timing device carries a number of terminals which contact in succession with an inner rotatable member and the casing is mounted to oscillate for a limited distance in order to vary the time of the spark as above referred to A disadvantage of this system is the fact that the casing cannot be held rigid and the time of the spark cannot be accurately controlled when the engine is operated at high speed Furthermore the oscillation of the cylinder casing and the rattle and jar due to the fact that it is mounted on a single short bearing are apt in time to break away the connecting wires In the timer here illustrated the casing is fixed and the timing is accomplished by a sliding sleeve mounted on a long bearing As shown in the accompanying engraving the device comprises a casing formed of three separate sections The section *A* contains the timing mechanism, the insulated section *C* a distributer, while section *B* serves to connect the other two sections and support the controlling lever A shaft *D* runs through the two sections and is geared to the engine shaft. Mounted on the shaft *D* is a sleeve *E* A pin *F* in the shaft engages the slot in the sleeve *E* which serves to couple the sleeve to the shaft *E* and yet permit the former to slide on the latter Mounted on the sleeve *E* in the timer section is a drum which carries a spiral metal strip *G* adapted to come in contact with a series of spring pressed balls mounted in but insulated from the casing As the shaft *D* revolves it will be observed that contact is successively made with the balls *H* which control the primary winding of the coil and that by sliding the contact strip *G* along the shaft *D* the time of the contact with respect to the position of the pistons will be varied The contact strip *G* may be moved along the shaft *D* by means of a lever *I* The opposite end of the sleeve *E* carries an insulating block in which a spiral contact strip *J* of the same pitch as the strip *G* is fitted The strip *J* is adapted to make contact with buttons *K* which correspond in position with the terminals *H* and are connected to the spark plugs A metal sleeve is fitted in the insulating block in contact with the strip *J* and this is adapted to receive a metal rod *L* which bears against a plate connected with the terminal *M* By this means electrical connection is always maintained between the strip *J* and terminal *M* no matter what position the sleeve *E* may occupy along the shaft *D* This arrangement is particularly adapted for use on low speed marine engines where a single coil suffices for all cylinders For high speed automobile engines a separate coil is required for each cylinder and hence the distributer can be dispensed with The inventor of the combined timer and distributer is Mr G T Brown of 225 West 80th Street New York City

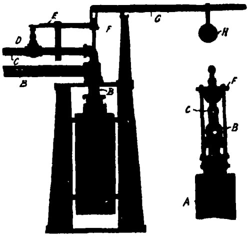


COMBINED TIMER AND DISTRIBUTER FOR INTERNAL-COMBUSTION ENGINES

◆

AN IMPROVED STEAM TRAP

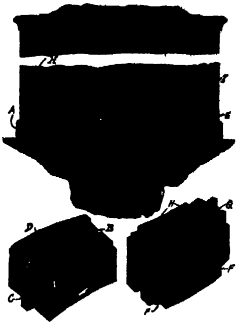
Pictured in the accompanying engraving is an improved steam trap which is of simple and durable construction and arranged to discharge the water of condensation periodically as required The apparatus comprises a closed vessel *A* into the top of which the steam supply pipe *B* opens Passing through the steam supply pipe and reaching to within a short distance of the bottom of the vessel *A* is the water discharge pipe *C* The vessel *A* is adapted to slide vertically on the pipe *B* and is provided with rollers that engage guide rails at opposite sides The steam supply pipe *L* is connected with the apparatus on which the steam trap is to be used so that the water of condensation accumulates in the vessel *A* The water discharge pipe *C* is provided at *D* with a valve A lever *E* presses against the valve stem at one end while the opposite end engages a cross piece *F* attached to the vessel *A* The cross piece is in turn connected by a link to a lever *G* which carries a weight *H* that may be adjusted along its length The weight *H* may be adjusted to lift the arm *E* so that it depresses the valve stem and keeps the valve *D* closed As the water of condensation accumulates in the vessel *A* it overbalances the weight *H* drawing down the cross piece *F* and with it the lever *E* and thus releasing the valve stem which springs up under tension of a small spiral spring The steam pressure in the upper part of the vessel *A* then forces out the water of condensation through the discharge tube *C* As soon as the water is discharged, the weight *H* lifts up the vessel *A* to its normal position The weight is so adjusted that it will act before all the water in the vessel is discharged, and will leave enough water in the vessel to seal the bottom of the discharge tube *C* and prevent steam from escaping therethrough. The inventor of this improved steam trap is Mr M J Hayle, 315 49th Street, Brooklyn, N Y.



AN IMPROVED STEAM TRAP

A NEW GRAIN BIN CONSTRUCTION

The grain bin illustrated in the accompanying engraving is designed to provide a dry and well-ventilated structure While the construction is such that it may be easily and quickly built, it will withstand great pressure from within The floor of the bin preferably slopes downward toward the center, leading to a chute that extends to a horizontal passage below, in which is mounted an endless belt carrier The walls floor and roof of the bin are preferably constructed of blocks or tiles of fireproof construction The first course of blocks of which the wall is formed are made as indicated at *A* Each block is provided with a recess at one side and a tongue at the other so that the blocks may be successively rabbeted together It will be observed that the block *A* is provided at its outer upper edge with a flange *D* which has a lug projecting inwardly therefrom The next course of blocks which are of the form indicated at *E* are provided with recesses *F* which fit over these lugs on the flanges *D* It will be understood that each course of blocks breaks joints with the course below it The blocks *E* are provided with grooves *G* adapted to receive metallic bands which are shown in section at *I* Each block *E* is provided with a pair of vertical passages *H* which are adapted to register with similar passages in the successive courses so as to form continuous passages from top to bottom of the bin The blocks in the intermediate courses of the wall are somewhat different in form from the ones shown at *I* but it is sufficient to state that they are provided with projecting lugs that enter recesses on adjacent blocks so as to form an interlocking construction The uppermost course of blocks differs from the others in having apertures *J* which provide communication between the interior of the bin and the vertical passages These apertures are above the grain line and afford ventilation of the walls The inventor of this grain bin construction is Mr Thomas Dougherty 624 18th Avenue South Minneapolis Minn.

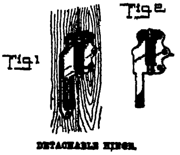


A NEW GRAIN BIN CONSTRUCTION

◆

ODDITIES IN INVENTION

Detachable Hinge—One of the bugbears of the man who has to do his own odd jobs around the house is the putting on and taking off of screen doors particularly if provided with spring hinges It is quite a difficult matter to apply the hinge without the help of an assistant holding the screen door The invention illustrated herewith aims to overcome this difficulty by making the hinge detachable A socket piece is permanently fastened to the door jamb and the spring hinge may be fitted into this socket piece or removed at a moment's notice.



DETACHABLE HINGE.

◆

Universal Cement.—4 parts alabaster plaster and 1 part of finely pulverized gum arabic mixed with a cold saturated borax solution into a thick paste, make an unequaled all-around cement for stone, glass, bone, horn, porcelain and wood, which becomes hard as marble and possesses the agreeable quality of not solidifying immediately after mixing, but [illegible] 24 to 36 hours.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

SUBSTITUTE BUTTONHOLE ATTACHMENT.—F [illegible], Denver, Colo. This attachment serves as an inexpensive substitute for frayed and worn-out buttonholes and may be quickly applied and detached without the use of any device other than the hands, and when applied presents a neat appearance and does not interfere with the flexibility of the surrounding material.

RECEPTACLE FOR BABY-CLOTHS.—C. [illegible], New York, N. Y. This receptacle is adapted to be set within the bowl of a water closet during the cleansing manipulation of the cloths and to retain no water when lifted therefrom. It is provided with a plug or stopper adapted to hold the water of the flushing system in the bowl.

Electrical Devices.

HAIR-DRYING APPARATUS.—W A Sozas, New York, N Y The invention is more especially designed for use in hairdressing establishments, barber shops and other places, and is arranged to insure drying of the hair by heated air and under the invigorating influence of artificial light, by the use of an electrically driven fan arranged in the rear of a cluster of electric lamps contained in a hood open at the front for the passage of the heated air and the rays of light.

Of Interest to Farmers.

MILK PASTEURIZER AND FILTER.—C C Stambaugh, New York, N Y In the present patent the invention has in view a simple apparatus for use in the pasteurization and filtration of milk, the pasteurizing and filtering being successively and continuously performed by passing the milk through a pail or vessel having the inventor's improvements.

Of General Interest.

PACKAGE-TIE.—H J Lee and E. F Gray, Scranton, Pa The purpose here is to provide details of construction for a package tie, which are simple practical, very convenient to tie or release a package, and that particularly well adapt the improvement for binding together a number of letters or documents in a compact package that may require separation quickly

SHEET-METAL TUBING.—W P Lawrence, Colorado Springs, Colo This improvement has reference more particularly to a construction of tubing for use in the frames of window sashes, window screens or for the uprights or transverse members of metal furniture, or for paneling or any other similar structure in which it may be desired to employ sheet metal tubing.

KNOCKDOWN BOX.—W L. Howland, Cedar Rapids, Iowa This hollow box frame is open at the top and bottom close around the inner sides of which is disposed a continuous piece of material projecting beyond the top and bottom of the frame and having its projecting portions cut and bent down and against the top and bottom of the frame so that when the top and bottom members are secured, the continuous piece of material will be held close to the inner sides of the frame, while it may be readily removed by removing the top and bottom members.

HAND MIXING RECEPTACLE.—A. Hallenberg, Fargo, N D. This inventor furnishes a receptacle for materials wherein the same may be mixed by compression of the walls of the receptacle He provides a receptacle to receive materials to be mixed, provided with finger holds to protect the fingers, and to provide holding means for the receptacle.

MEANS FOR HANGING DOORS SCREENS, ETC.—T Gill, Follansbee, W Va. The means consists in the main of a post or column of a length nearly equal to the height of the door opening or casing and provided with a suitable adjusting device for extending its length until it clamps at its ends against the door casing with sufficient force to retain it in place, the door being hinge-connected to this post in the usual manner of connecting it directly to a door casing.

BUTTER AND LARD CUTTER.—C. H. Carlson, Iron Mountain, Mich. The aim in this instance is to provide a device especially adapted to cut out and remove a shaped pat of butter or lard from a firkin or other receptacle, and which is provided with means for ejecting the pat from the device without the necessity of touching it with the hands or any tool.

Hardware.

BENCH-STOP.—M. R. Raynesford, Ellis, Kan. This invention relates to stops, and more particularly such as are adapted to be used on carpenters' benches for holding one end of a board firmly against the apron of a bench while the opposite end of the board is clamped in a vise. It constitutes an improvement on the device shown and described in a U. S. patent formerly granted to Mr. Raynesford.

HOSE-COUPLING.—W. F. [illegible], Chillicothe, Ohio. In using this invention, the head piece is introduced in the terminal of the [illegible] member having an [illegible] and it is rotated in the terminal until [illegible] the stems of the T-shaped members are in alinement with the slots that separate the pairs of lugs, when the head piece is pulled outwardly until the T-shaped members interlock with the inner faced lugs. In this position the head piece protrudes through an opening in the rubber cup.

Household Utilities.

CLOTHES-LINE HANGER.—C C. Lovejoy, New York, N Y The device may be conveniently attached, and will operate to support the line in such a way that the end of the line may be brought into the room to enable the clothes to be hung thereupon, and the device may be readily folded up out of the way when not in use

CLOTHES-LINE TIGHTENER.—R. C Schuurman and L. Marek, Union Hill, N J This invention pertains to clothes line tighteners, and the object of the inventors is to produce a device which can be readily applied to a clothes line, which will enable the slack of the line to be taken up and which will maintain the line under tension

Machines and Mechanical Devices.

DEVELOPING MACHINE FOR PHOTOGRAPHIC FILMS.—Elizabeth A Taylor, Steilacoom, Wash This invention consists of a plurality of cylinders of different diameters disposed one within the other, there being slots in the cylinders, and projecting therein which engage each other so that when one cylinder is rotated a predetermined distance the projection thereon will engage the one on a neighboring cylinder to rotate it In use the end of the film is secured to one of the cylinders and as they are rotated the film is wound around them, the film passing through the slots from one cylinder to another

Musical Devices.

REED-ORGAN.—L. A. McCord, Laurens, S. C It is sought in this invention to provide an organ attachment which can be applied to any of the ordinary reed organs and will permit the playing of the organ by an automatic or self player such for instance as those using a certain perforated paper strip or sheet, and which self playing attachment may be adjusted out of the way so the organ may be played in the usual manner

ADJUSTABLE PIANO-PEDAL CONNECTION.—H Meyer, New York, N Y The intention here is to provide an adjustable piano pedal connection arranged to insure accurate working of the hammer rest rail, the damper rail and the muffler as desired. The connecting bar is adjustably secured to a flat spring, which forms the fulcrum for the bar and is attached to a base secured to the bottom of the piano frame

Railways and Their Accessories.

RAILROAD-TIE.—J W Snedden, Falls Creek Pa Disclosed in this patent is a tie the sides of which are connected below the top by a web, the upper edges of the sides having inwardly projecting flanges between which the movable member of the rail fastening means coact with fixed rail retainers at the opposite side of the rail The tie is hollow and between the walls either a filling of concrete or a block of wood is adapted to be received

BLOCK-SIGNAL SYSTEM.—J D Nix, Ferriday La An object of this inventor is to provide a mechanism which is located on the engine and forms part of the mechanism thereof which may be automatically operated by an electric current from a generator carried on another engine which is in the same block The generators for furnishing the current may be either dynamos or batteries.

FLAG OR SIGNAL.—G W Dallimore, Pocatello, Idaho The object here is to produce a flag for use on railways having a pole or staff within which the curtain or body of the flag may be received when the signal is not being displayed, and further, to provide a simple construction enabling a flag to be extended or withdrawn from view

CAR-FENDER.—G A. Estlee, Standish, Mich In this fender, a catching and supporting means prevents injury to a person with whom the fender has forcible contact, and the purpose of the invention is to provide for a fender effective in service, and which may be placed on street or other cars for service without requiring changes in the construction of the cars.

LOCK VALVE.—T M. Swank, Louisville, Ky This valve is for use in connection with the train pipe of an air brake system, which has locking mechanism serving to prevent unauthorized and malicious tampering with the valve, which also prevents accidental closing of the valve when open, and which will not cause unnecessary delay in certain operations such as in switching or coupling cars.

AUTOMATIC TRACK INSPECTOR.—T Ellis, Tacoma; G H Purvis, Seattle, and J S. Crissom, Raymond, Wash. The invention relates to automatic track inspectors, that is, to mechanism for indicating the condition of a railway track. More particularly stated it comprises various improvements, whereby the general efficiency of such mechanism is greatly increased, and the operations rendered more [illegible].

Pertaining to Recreation.

COMBINED CREEL AND KIT.—H. W Wakefield and C. F Harter, Seattle, Wash. The improvement is in anglers creels, the purpose of which is the provision of a kit in connection with the creel or basket for the storing of hooks, lines, leaders and other fishing paraphernalia, in order that the same may be at all times readily accessible and thus facilitate the replacing of lost hooks, etc.

GAME.—H. E. Hire, Mark Center, Ohio. Mr Hire's invention relates to games, and the object is to provide a game which has many of the features of the game of base ball and is especially devised to assist in the training of pitchers for the outdoor game of base ball, and to test their skill at the outdoor game

TOY CANNON.—W H. Cornford, Mornington, Victoria, Australia. This application is in part a division of the application formerly filed by Mr Cornford for Letters Patent on a military game or toy and the present invention relates to a toy cannon or gun of special construction adapted to be used in connection with the said game It provides for rapid firing of pellets, retaining them in position till fired, automatically readjusting them if displaced, and means for elevating and depressing the cannon.

Pertaining to Vehicles.

INFLATING DEVICE FOR TIRES.—E. Haynes, Hisbee Ariz Ter This invention is particularly useful in connection with pneumatic tires such as are used on motor vehicles and the like The aim is to provide an efficient device for tires, which is automatic in operation and which obviates the necessity for manually or otherwise extraneously inflating a tire

VEHICLE-TIRE.—C F Fisk, Allentown N J The invention consists of a rim of two sections bolted or otherwise detachably secured to the felly and having relatively deep outwardly-extending flanges, with a shoe rim at the outside of each flange a tire having resilient ribs in engagement only with the inner faces of the flanges and the tire and ribs otherwise disengaged from the rim, a shoe extending around the tread of the tire having its edges located in the shoe rims, and clamping rings securing the shoe to the shoe rims.

DRIVING-GEAR FOR AUTOMOBILES.—E G Whitacre, Wellsville Ohio This invention relates more particularly to the mounting for the driving engines used in automobiles. The style of the engine may vary but any form wherein the motive power is a gas under pressure will serve. It might be used in internal combustion engines provided any of the well known relief valves were used in conjunction with one or the other of the engines, which would be operated automatically as the automobile is driven in a curved path The valve would lessen the power stroke on the engine on the inner side of the curved path being followed by the automobile.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each Please state the name of the patentee, title of the invention and date of this paper

Notes and Queries.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of March 13th or will be sent by mail on request.

(12136) A. R. S. says 1 Why when the moon is growing can one see a bright outline of that satellite, while the inner portion of the circle appears dark? A When the moon is within two or three days of new the earth reflects light enough from the sun to make the dark portion of the moon visible The earth at that time is full as seen from the moon This is called seeing 'the old moon in the new moon's arms.' The light is called 'earthshine' It is described in the astronomies, such as Todd's 'New Astronomy' which we send for $1.50 See page 225 2. Why do moon and sun appear to be much larger when rising and setting? A The sun and moon seem larger near the horizon by an optical illusion due to contrast. With an instrument they do not measure any larger near the horizon The sky itself is affected in the same way Stars seem farther apart 3 How can I locate the following planets Mercury Mars, Jupiter Neptune Venus? A. The position of the planets is given each month in our article 'The Heavens in September' etc The proper thing to do is to become a subscriber to the Scientific American and have the instruction given in the paper Neptune cannot be seen excepting with a good telescope The rest you name may be seen with the unaided eye. Mars is now very bright in the night sky 4 What size wire will be necessary to wind an ordinary telephone generator for ten volts? How many turns will be required? A A telephone generator is wound with wire from No 30 to No. 35 and from 75 ohms to 550 ohms. From this you will see that we cannot tell you what to use. If you would make a generator to work with others, you would better copy one of the others.

(12137) C L. L. says Two horses are attached to opposite ends of a rope and are pulling against each other Both horses are capable of pulling 200 pounds apiece. Is there more strain on the rope with the horses pulling against each other than if one end of the rope is attached to an immovable stake and only one horse pulling it? A The pull upon the rope with a horse pulling 200 pounds at each end is 200 pounds. One horse is but a post for the other to pull against and a post can as well be used as a second horse This anyone can prove by having two persons pull against each other on a spring balance and then letting one person pull with the balance fastened to a hook on the wall or to a hitching post in the yard If the balance will indicate all that a person can pull the experiment will be identical with the one you propose

(12138) F S says Some time ago we wrote to an electrical supply house asking them whether the numbers in the Brown & Sharp wire tables followed any regular law and were told that they did not We are of the impression that the people we wrote to concerning this question must be mistaken, and are writing you, and would like to have you either confirm or deny their statement A The sizes of wires by Brown & Sharp's, or as it is better termed the American wire gage are not determined by any formula but are a growth. However the sizes are such that a wire three sizes larger will have a sectional area about double that of a given wire This is only an approximation It is very convenient in electrical work. See our article, 'How to Remember the Wire Table' in Supplement No 1,590 price ten cents.

(12139) W B H says 1 Why is a magneto used to make the spark for a gasoline engine in preference to a small dynamo? A The field of a magneto is always ready for use and does not require to build up its magnetism as a dynamo does. 2 Why are the permanent magnets of a magneto divided up into several instead of one large one? A. A compound magnet made from several thin magnets is much stronger than a single magnet of one thick piece of steel

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AND EACH BEARING THAT DATE

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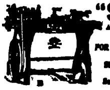

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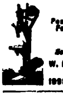

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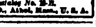

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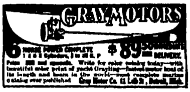

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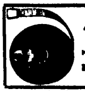

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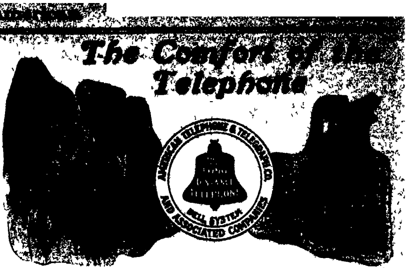
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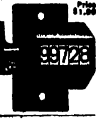

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Scientific American Supplement 1538 gives the proportion of gravel and sand to be used in concrete.

Scientific American Supplements 1567, 1568, 1569, 1570, and 1571 contain an elaborate discussion by Lieut. Henry J. Jones of the various systems of reinforcing concrete, concrete construction, and their applications. These articles constitute a splendid text book on the subject of reinforced concrete. Nothing better has been published.

Scientific American Supplement 997 contains an article by Spencer Newberry in which practical notes on the proper preparation of concrete are given.

Scientific American Supplements 1568 and 1569 present a helpful account of the making of concrete blocks by Spencer Newberry

Scientific American Supplement 1534 gives a critical review of the engineering value of reinforced concrete.

Scientific American Supplements 1547 and 1548 give a resume in which the various systems of reinforced concrete construction are discussed and illustrated.

Scientific American Supplement 1564 contains an article by Lewis A. Hicks, in which the merits and defects of reinforced concrete are analyzed.

Scientific American Supplement 1551 contains the principles of reinforced concrete with some practical illustrations by Walter Loring Webb.

Scientific American Supplement 1573 contains an article by [illegible] on the [illegible] of [illegible]

Scientific American Supplement 1574, [illegible]

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NEW BOOKS, ETC.

Railroad Structures and Estimates. By J. W. Orrock, C.E. New York: John Wiley & Sons, 1909. 8vo., 270 pp., 93 figures. Price, $4 net.

Under the title of Railroad Structures and Estimates, the intention is to cover in brief and concise form the numerous subjects that enter into the Engineer's Estimates of Rail road Building, for the purpose of ready reference, as to general construction and cost, on a business rather than a technical basis. As it is impossible to give the data to suit all conditions, the weights, quantities, and cost are given in detail in most instances, and may be varied as desired.

Framing. By William A. Radford. Assisted by Alfred S. Johnson, A.M., Ph.D., and Bernard L. Johnson, B.S. Chicago: The Radford Architectural Company New York Industrial Book Company 12mo., 388 pp. Price, $1.

To the carpenter especially, and to all others interested in wood in a structural way, this is a most important subject. The framing of a building has been likened to the skeleton of the human body It is important that it be put together properly and connected up in the right way The whole stability and success of the edifice depend on the strength and proper arrangement of the supporting frame. The present work is divided into four heads (1) Timber framing for houses, (2) barn framing, (3) framing of factories, stores, and public buildings, (4) miscellaneous framing, including strength of timbers and the principles of truss construction The work, accordingly will be taken up in this order In some cases certain subjects of an introductory or explanatory nature will be discussed, although, strictly speaking, they are no part of "framing" and possibly are not done by the carpenter Yet a knowledge of them will add to the carpenter's equipment, and will help him to do his work more intelligently

Metal Spinning. Practical Instructions in a Fascinating Art. By Fred D Crawshaw, M.D Chicago Popular Mechanics, 1909 18mo., 72 pp Price, 25 cents.

Like so many of the other old-time crafts, the one of metal spinning has partially gone into disuse because of commercial competition and the failure of the younger generation of men to familiarize themselves with the handwork of their fathers. In the United States it is only in the larger cities that one finds an artisan who does metal spinning. When such a person is found, he is usually occupied in producing forms out of thin metal that require great care in making and are difficult to produce with the stamp or press. It is believed in some circles, particularly among metal spinners, that the pressing and stamping of metal can never fully take the place of spinning it. The object of this book is to assist amateurs in an interesting art, and also give practical metal spinners additional instruction.

The Scientific American Boy at School. By A. Russell Bond. New York Munn & Co., Inc, 1909 Pp. 338. Price, $2.

One of the most interesting and helpful of recent books for boys was "The Scientific American Boy," by the accomplished author of the present volume, in which was described the adventures of a youth of mechanical turn of mind with his companions in a vacation season Mr Bond now carries the story further, places his hero in boarding school, and invites his readers to enjoy his later adventures, and profit by them as well. It is pre-eminently a boy's book for boys, for boys with sound bodies and healthy minds, who like to be out of doors and making things with their hands—just the kind of boys one reads about and would like to have or know, but who sometimes seem rather scarce when one scans the list of one's boy acquaintances. Mr Bond has been more fortunate than some of us, for his boys are fine young chaps, full of life and vigor and endowed with mechanical turns of mind that must have given some of their elders pause But at all events they are not prigs, but good, wholesome boys of the right sort, and if one does not meet them in the streets every day it is good to know there are such young people and to read about them in Mr. Bond's agreeable pages. The book is not at all a history of school life, but might be scientifically described as an essay on surplus energy It deals, not with what the boys did in school hours, but what they did outside of them. These, of course, are the real hours of a boy's life, the time in which he is free and unrestrained, in which he seeks to please himself and work off some of that boy energy that is sometimes not always so appreciated by his elders as it might be. So the book brims over with good nature and ingenuity and with the breath of outdoor activity If the mechanical performances of these young fellows seem sometimes a bit audacious, we may rest assured, with the author's certificate, that they never did anything boys of real earnestness and ingenuity could not have accomplished. The careful parent may perhaps be disposed to pause a little at the flying machine, but—read Mr. Bond and find out what happened. The book is agreeably written with a sympathy for boy life and boy [illegible]

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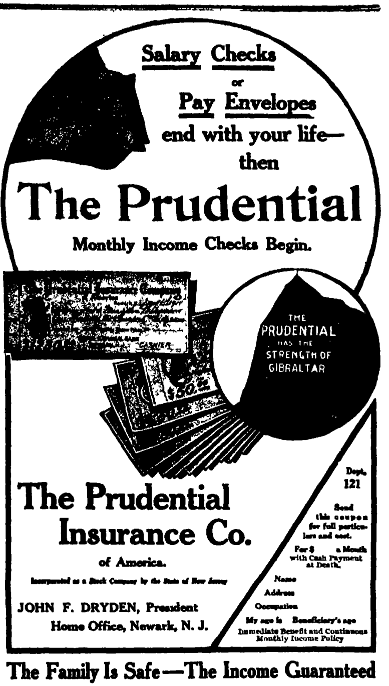
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who wishes to interest his boy in the value of thinking and doing. The numerous illustrations are extraordinarily helpful and practical.

Handy Man's Workshop and Laboratory. Compiled and edited by A. Russell Bond. New York: Munn & Co., Inc., 1909. Pp. 467. Price, $2.

This is a book of first rate importance and interest, and is a notable contribution to practical work from the office of the Scientific American. It is a book that not only aims to be practical but which is practical from cover to cover. It is a collection of ideas and methods, of ways to do things, of what to do and how to do it as proposed, tried out and tested by resourceful men, both amateur and professional. It contains, in short, upward of a thousand ingenious "kinks," ideas, and hints, useful to the household, attractive to the mechanic, and interesting to everyone who loves to tinker and make articles of use and value, or in whom the spirit of experimentation is inbred. Unlike many books of this kind, however, this is no collection of scientific experiments. In fact, it is not an experimental book at all, but a treatise of useful things. It is not concerned with theory but with fact. It deals, not with what will give curious results, but with achievements of real value and utility. And this it does in the most direct way possible. The descriptions of methods are concise and clear, and at every point they are supplemented with drawings and diagrams, many of which are in the form of working drawings that show, in a very precise and definite way, just what to do, and how to do it. There are 370 such illustrations in the book, very clearly drawn and lettered, and illustrations that illustrate in the best sense of the word. The origin of the book is a department established some time ago in the Scientific American, devoted to the interests of the "Handy Man." A flood of suggestions poured in from a multitude of sources, and the best of these have been reproduced in the present volume. It is, however, in no sense a reprint from the Scientific American, since much of its contents is now printed for the first time. Mr. Bond has devised a book that will very successfully appeal to a very wide circle. The amateur workman is attracted by the opening chapter on fitting up a workshop. Both he and the professional mechanic will find a host of suggestions on the greatest diversity of topics in the next chapter on Shop Kinks. Both again will be interested in the very valuable chapter on the soldering of metals and the preparation of solders and soldering agents. Here is a long list of formulas for solders of tried and tested accuracy. The professional mechanic is especially appealed to in the fourth chapter on the Handy Man in the Factory, while still another class of readers will be interested in the fifth chapter on the Experimental Laboratory. Electricity is very fully treated in the sixth chapter, and the householder will find a wealth of suggestion in the numerous devices described in the seventh. The sportsman will be helped with the hints of the eighth chapter, while the final chapter on flying machines is of the greatest possible present-day interest. It is, in short, a book of the widest general interest, and both editor and publisher are to be heartily congratulated on the success obtained in this very valuable publication.

Concrete Pottery and Garden Furniture. By Ralph C. Davison. New York: Munn & Co., Inc., 1909. Pp. 196. Price, $1.50.

The publishers' statement that this is a new book on a new subject is very true. Neither concrete pottery nor concrete garden furniture is in itself new, but a book dealing with their making by the amateur has not heretofore been published, and hence this volume amply supports the claim of novelty made for it. Readers of American Homes and Gardens have already acquired some familiarity with Mr. Davison's guidance in this fascinating art, and while the articles he contributed to these pages have been reproduced in this book, they have been given a new form and much new and additional matter has been added to them. The illustrations have been greatly increased in number, and the whole given the form of a practical handbook. Books on handicraft of any kind are apt to fail, more or less, in the inadequacy of their directions. The author, too, often knows so well what to do and how to do it as not to realize that those who have not followed the work before may not quite follow what are supposed to be careful directions. Mr. Davison has been fully alive to this misfortune in books of this kind, and has, therefore, taken especial pains to make his descriptions most accurate and detailed. No other method is, of course, really feasible; but it is seldom this sort of thing has been so well done as in his pages. The careful text is supplemented with illustrations as carefully made and lettered, so that the book is a genuine handbook of craftwork, thoroughly practical in every part and admirably adapted to its special purpose of explaining every portion of the work involved in the production of the various articles described. Mr. Davison has opened up quite a new field for the amateur. The materials required are abundant and cheap, the methods, in the simpler pieces at least, easy and devoid of difficulties. And the work is not only pleasant, but the results are agreeable and decorative. The author thoroughly knows and understands his subject, and has the gift of imparting his knowledge to his readers.

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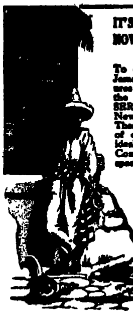

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SCRIBNER'S MAGAZINE 1910

THEODORE ROOSEVELT'S own and exclusive account of his *African Trip* will continue to be a very important feature of the Magazine during a greater part of 1910.

The articles already published have met every expectation with regard to their exceptional interest and value, and the extraordinarily large editions required to meet the demand have had to be increased with each number. Nothing he has ever written has better revealed his own attractive personality, his remarkable faculty for observation and appreciation of the picturesque and unusual in both humanity and nature. The *Boston Transcript* says:

"Mr. Roosevelt has a unique way of feeling as the American nation feels. His general sympathies, modes of thought and emphasis, and even his prejudices are largely theirs. That fact makes Americans follow with zest the story of his hunting in the wilds, told with the same grim strength that has made his political utterances so far-reaching and deep in their influences."

In the January number he will describe hunting experiences at

Juja Farm: Hippo and Leopard

These articles are not only fascinating narratives of adventure, they are also authoritative accounts of the natural history of many animals but little known to most readers. The illustrations by Kermit Roosevelt and other members of the expedition are especially interesting. To secure all of Mr. Roosevelt's articles subscriptions should begin with the October number.

THE WELLCOME TROPICAL RESEARCH LABORATORIES AT KHARTUM.

(*Continued from page 375*)

under the direction of Dr C N Wenyon, proto-zoologist to the London Tropical School of Medicine, and proved such a complete success that the work in this direction is being considerably developed

Entomology is another very promising science that has claimed considerable attention in these laboratories There is an immense field in the Sudan for an economic entomologist, and the scope and variety of the work done is almost bewildering. There are pests of every kind infesting every living being and plant, and the task of reducing these would at times seem almost hopeless. Every year taxes aggregating large sums, have to be remitted owing to the ravages of *Aphis sorghi* and other pests Fatalism, natural indolence, and improvidence often prevent the natives, unless supervised, from taking those active measures so necessary in cases of insect infestation of crops. These labors have also a direct bearing on tropical medicine, as results have abundantly testified

In the field of anthropology very valuable work has been accomplished. The laboratories are recognized as a working place for fellows of the Carnegie Research Fund, and on the recommendation of the director, Dr A. MacTier Pirrie was appointed anthropologist to the Institution. In addition to his medical qualifications, Dr Pirrie held a special degree in anthropology, and was particularly well versed in physical work Although he labored under the great disadvantage of not knowing the country he undertook and successfully completed remarkable journeys into the totally unknown Burun country, which lies between the White Nile and Abyssinia. He lived and moved among the tribes inhabiting this territory, and his method of handling the natives was highly appreciated by the government By his free movement among them he was able to acquire extensive data of their life, manners, and customs of the most highly prized character Unfortunately, these expeditions proved fatal to the young, enthusiastic investigator During one journey he contracted an indigenous disease propagated by the parasite of kala-azar He was prostrated and invalided home to Scotland but died six months later before he had the opportunity of setting out the results of his work. His notes and observations, as well as those of archæological and ethnological aspect were worked up by competent authorities and have thrown much light upon a people and their country about which nothing has previously been known

The chemistry section has received as much attention as tropical medicine, for it has an important bearing upon the commercial development of the country The principal fields of investigation in this direction have been Sudan gums, food-stuffs, and seeds, as well as water supply from the Blue and the White Nile and wells. The study of gums has been particularly exhaustive. The Sudan has extensive forests of gum trees in fact, such constitutes one of its staple products. Inquiry showed that comparatively little was known about gums so that great attention was concentrated upon this subject. After some four years of labor, the laboratories have made some valuable additions to the chemistry of this commodity, and it is hoped that their labors may result in placing the Sudanese gum industry upon a sound basis

Unfortunately, on May 11th 1908, the laboratories suffered a heavy calamity in a fire, which breaking out in the photographic dark room practically gutted the building, except the library, directors room, and one or two other departments Not only was a very large quantity of equipment destroyed but all the trypanosomiasis specimens were lost, together with the records of two years work on the subject. Nearly all the paraffin blocks prepared during the previous

(*Concluded on page 383*)

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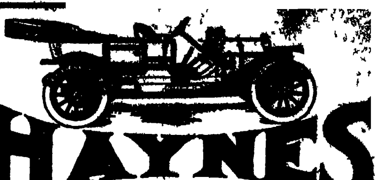

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ARTILLERY FOR AIRSHIP ATTACK.

(Concluded from page 373.)

is clamped tight against the axles. The third type of cannon is of a much heavier build than the two which precede, seeing that in this case it is designed to be mounted on shipboard, and hence the weight does not need to be reduced as in the other cases. It is of a considerably larger caliber, this being 10.5 centimeters (4.2 inches) In most of the details it is designed on the same lines as the second type. It is intended to be mounted generally upon torpedo boats or swift cruisers, and naturally the gun can be brought into service as an ordinary cannon in cases where it is needed. For the gun proper, the weight is 3 080 pounds, while the support weighs 3,520 pounds, giving a total weight of 6 600 pounds for this type. Like the former, the angle of elevation is 75 degrees at a maximum. The projectile, weighing 40 pounds, has an initial speed of 2,300 feet per second. A horizontal range of 44,500 feet is reached in this case, and we have the unusual height of 37,620 feet.

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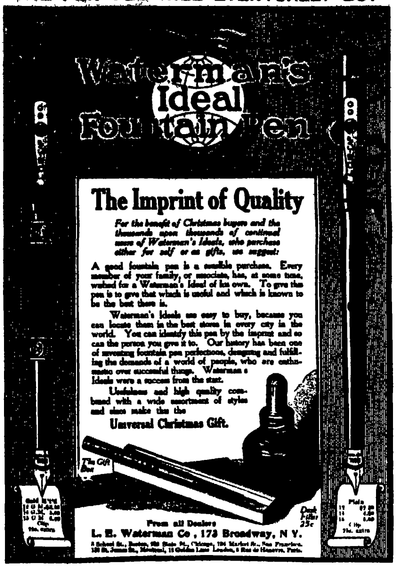

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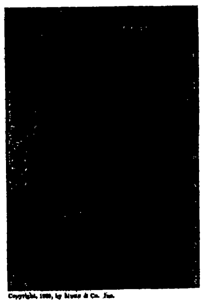

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The Middle West Number of the SCIENTIFIC AMERICAN

On December 11th, 1909, the Scientific American will issue a number devoted entirely to the wonderful Middle West region of the United States, a number which will set forth broadly and lucidly not only the agricultural interests of that region, but also those larger engineering undertakings which are destined to transform the Middle West in part at least, into a manufacturing territory

With that object in view the Middle West Number will publish articles on the following subjects:

I. The Chicago and Gulf Waterway.—An illustrated description of Chicago's drainage canal, an engineering work which stands without a parallel in the world.

II. Chicago as a Railroad Center.—Chicago is the greatest railroad center in the world.

III. The Wonderful Grain Trade of Chicago.—Chicago is an enormous wheat bin, into which most of the grain raised in the middle West is poured.

IV. Shipping on the Great Lakes.—Most of the iron ore that is now smelted in Pennsylvania is mined in the middle West. To transport it to the blast furnaces of the East at a cost which will enable American steel makers to compete with foreign steel makers, it has been necessary to devise a new kind of lake transportation. Ships of [illegible] and [illegible] tons burden have been constructed which convey ore at small cost through the Great Lakes, and which are without a counterpart anywhere in the world.

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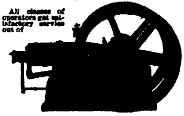

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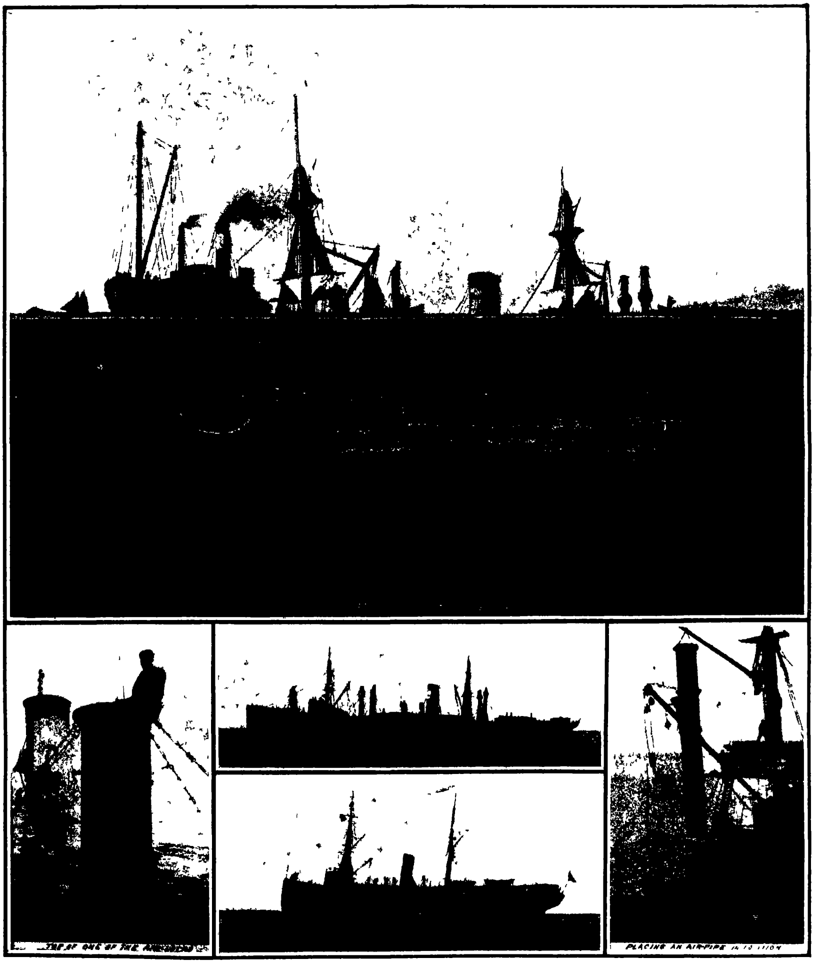

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SALVAGE OF THE U. S. S. "YANKEE" BY COMPRESSED AIR.—[See page 388.]

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NEW YORK, SATURDAY NOVEMBER 27th, 1909

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PRESENT CONDITIONS ON THE PANAMA CANAL.

A careful reading of the Annual Report of the Isthmian Canal Commission, now before us warrants the statement that, save for some extensive and troublesome slides in the Culebra cut, the whole of this great work of engineering and administration is prosecuted without mishap, and with every prospect of its completion by the year 1915

During the year the designs for the upper locks at Gatun and the locks at Pedro Miguel were completed. The locks are built in pairs, separated by a solid wall 60 feet thick they are 110 feet in width and have 1,000 feet of usable length They will be emptied and filled through lateral culverts under the floors, connecting with large longitudinal culverts in the side and center walls operated by Stoney valves In all plans for the canal, it has been laid down as a fundamental feature of design that at each pair of locks there must always be two barriers separating the high level from the level next below The extra or collision barrier consists of a set of hinged, vertical, mitering gates, and a massive chain barrier controlled by capstans in the walls. As over 95 per cent of the vessels of the world are less than 600 feet long, intermediate gates have been introduced dividing the lock chambers into two parts suited to vessels 550 and 350 feet in length respectively The intermediate gates are also protected by a chain barrier An emergency dam, which will cut off the flow of water in the event of a gate being carried away will be provided at the head of the locks. The design consists of a swing bridge from which girders, supporting specially designed wickets are lowered the bottom of the girders resting on sills at the bottom of the lock

The various materials of the foundations for the locks have been tested by trial loads and found to have sufficient resistance to carry safely the greatest loads that will be brought upon them by the structures. Curtain walls will be built to stop any underflow and to prevent the concrete floors being lifted by the pressure of any water which might gather below them, they are being thickened and anchored down to the underlying sandstone by the old rails left from the French administration The plant for the rock crushing and the mixing of the concrete is installed and in successful operation Concrete laying has commenced, and by the last of October 41,236 cubic yards had been put in place

Reference is made in the report to the sensational rumors of bad slides which were sent out at one time from Panama. They were occasioned by a subsidence of no consequence whatever, which occurred to one of the rock fills at the toe of the Gatun dam It is admitted that the most practical question in the construction of the dam is the sliding of the material underneath and in the body of the dam The question of its sliding depends upon the slope of its outer face, and since the dam which has a height of 115 feet above sea level, has more than a mile of horizontal thickness at its base the Report is certainly justified in stating that the stability of this great work goes far beyond the limits of what would be considered sufficient and safe in any less important structure. The excavation for the spillway in the center of the dam is completed, and the channel below the dam, 960 feet long and 285 feet wide, is being concreted.

The dredging fleet has removed from the channel between the Gatun dam and deep water in the Caribbean Sea, a total of over 6,000,000 cubic yards, and at the present time some three miles of the channel from deep water (41 feet at mean tide) have been completed. Limon Bay, through which the entrance to the canal will be made, is exposed to strong winds and heavy seas. To protect the entrance channel, two breakwaters, one 10,000 and the other 3,500 feet in length, are to be built.

In the central division, including the basin at Gatun Lake and the great Culebra cut, progress has been very satisfactory Although the Report covers the year only up to June 30th, we may add that on October 23rd, when 39,022,299 cubic yards had been excavated, the work that remained to be done in the Culebra cut when the Americans took over the work was half completed Including the work done by the French, this means that two-thirds of the whole work has been done Slides in the Culebra cut continue to be a source of annoyance One of these measures 2 700 feet along the cut, and involves about 27 acres of moving material Already 677 000 yards have been removed, and as much more is still in motion There are smaller slides which bring up the total amount of material in motion to 1,000,000 cubic yards. These slides will necessitate easier slopes to the cut at the points where they occur, and will add to the total yardage, otherwise they will have no effect upon the canal

In the Pacific division, the locks at Pedro Miguel are founded on durable rock of such excellent character that a part of it will be left in place to form the separating wall between the lock chambers. The excavation for the locks is practically complete The West dam is being constructed of rock and earth with puddled clay as a center and the material underlying the dam is impervious At Miraflores about one-half of the excavation for the lock has been completed, and the general plans for the dams have been approved

Excellent progress has been made on the entrance channel on the Pacific, from which during the year 8,475 931 cubic yards was removed The channel has been carried to full depth for about five miles from deep water

Due mainly to the great increase in the dimensions both of the prism of the canal and of the locks, and to the higher cost of labor and materials, the estimate of the total cost of the completed work shows an increase over the original estimate of nearly fifty per cent. The total cost of engineering and construction will be $297 766,000 and if the purchase price and the cost of sanitation and civil government be added, the total final cost will be brought up to $375 201,000

THE TRIALS OF THE BATTLESHIP "NORTH DAKOTA"

The government acceptance trials of the battleship "North Dakota," of which we gave a preliminary account in our issue of November 13th, have now been successfully completed, with results which are gratifying alike to the Navy Department and the builders of the ship

When the question of installing turbines in place of reciprocating engines in the new warships of our navy first came up for discussion the attitude of the Bureau of Steam Engineering was decidedly conservative. The Department felt that sufficient experience was not available with the turbine at least under battleship conditions to warrant its immediate adoption at the time it was proposed Ultimately, however it was decided to install the Curtis turbine in one of the two battleships authorized by Congress in March 1907 and to equip the sister ship with standard marine reciprocating engines.

Now that the trials both of the "Delaware" and the "North Dakota" have been completed it is possible to make a reliable comparison of the two types of engine, and it is gratifying to know that on every point of comparison except those of water consumption and propeller efficiency, the turbine has shown its superiority In the standardization trial the "North Dakota" ran her fastest mile at a speed of 22 25 knots, and made an average speed for the five runs of 21.83 knots. She showed a maximum horse-power for one mile of 35,150 In these trials she exceeded the mean speed of the "Delaware" by 0 39 knot, and her turbines developed over 5,000 more horse-power The results of the three hours' full-power trial, and the runs for twenty four hours respectively at 19 knots and 12 knots, as herewith given, are highly satisfactory Aside from the fact that she attained a full-power speed of 21.64 knots against the contract requirement of 21 knots the most satisfactory feature is the remarkably low coal consumption of the ship, particularly at low speed—for one of the most serious charges formerly made against the turbine was that of its extravagance in coal consumption under low-speed conditions. The coal per horse-power per hour for the total horse-power worked out at 1.68 pounds at full speed; at 19 knots speed it was 1.58 pounds and at 12 knots it was 2 34 pounds. The coal per horse-power per hour of an equivalent indicated horse-power (the power was taken by torsiometer from the propeller shaft) works out for the three speeds, respectively, as 1.55, 1.46, and 2.15 pounds per horse-power per hour With the ship at her maximum displacement, the steaming radius of the "North Dakota" would therefore be 3,000 knots at 21½ knots, 4,600 knots at 19 knots, and 6,000 knots at 12 knots speed. Compared with the reciprocating-engine-driven "Delaware," the turbine-driven "North Dakota" required only 295 as against 315 tons of coal per twenty-four hours on the 19-knot trial, and 105 as against 111 tons on the 12-knot trial.

OFFICIAL TRIALS OF THE "NORTH DAKOTA."

	3 hours of full power trial.	24-hour trial at 19 knots.	24-hour trial at 12 knots.
Actual average speed	21.64	19.24	12.05
Revolutions per minute	280.4	231.9	143.2
Shaft H P of main turbines	31,400	16,710	3,800
I H P of engineer's auxiliaries	1,100	680	400
Water rate of main turbines only	13.6	14.2	20.5
Water rate for all engineer's purposes based on total H P.	13.96	15.29	22.8
Coal used, pounds per hour	54,400	27,550	9,820
Coal used, tons per 24 hrs.	583	295.3	105
Coal per hour per shaft H P of turbines	1 74	1 65	2 58
Coal per hour per shaft for total H P	1.68	1.58	2.34
Coal per hour per shaft of equiv I H P *	1.55	1 46	2 15

* Based on 6 per cent friction for reciprocating engine

	Specified in Contract	Actual.	Saving. Per Cent
3 hours of full power trial	15 1	13 96	7 5
24 hour 19 knot trial	16 1	15 29	5.0
24 hour 12 knot trial	23 2	22.3	3.9

The "North Dakota" is driven by two Curtis turbines the pitch diameter of whose moving buckets is 144 inches. There are nine stages for going ahead and two for going astern The shaft diameter is 30 inches and the bearings at each end of the turbine are 21 inches in diameter by 42 inches long. The steam, superheated fifty degrees enters the steam chest at a pressure of 280 pounds absolute. Here it passes through twenty nozzles, where it is expanded and acquires a velocity of 2,000 feet per second, its pressure falling to 75 pounds absolute It then passes through another set of nozzles between the first and second stage, where it acquires a velocity of 1,070 feet per second leaving the blades with a velocity of 155 feet per second. The pressure in the second stage is 49 4 pounds absolute From the second to the eighth stage the entrance velocity of the steam remains at 1,070 feet per second, and the exit velocity at 155 feet per second. The pressure, however, drops from 75 pounds in the first stage to one pound absolute in the ninth stage, at which pressure it passes to the condenser, where a vacuum of 28½ inches is maintained It can thus be seen that as the steam traverses the successive stages there is a continual drop in pressure, the energy of the steam being delivered to the moving blades in the form of impact, the velocity of which is developed by expanding the steam in series of nozzles forming the entrance to each stage. The number of nozzles increases from 20 in the first stage to 360 at the sixth stage The buckets in the first stage are 1¼ inches in length and they increase to a length of 12 inches in the last stage.

In the two stages of the reverse turbine, it has proved possible to develop about 60 per cent of the power that can be developed on the go-ahead turbines, and thus the objection which has been raised against the turbine that it provides insufficient maneuvering power may be considered to be pretty well met. In this connection it may be mentioned that in the trials of the Japanese cruiser "Ibuki," which is equipped with turbines of this type, when the ship was steaming at 20 knots, it was possible in reversing to stop the starboard turbine in 22 seconds, the port turbine in 25 seconds, and bring the vessel to absolute rest in two minutes.

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The ancient Romans commonly wrote with a metal point (stylus) on wooden tablets covered with wax (tabulae), but permanent records were written on parchment with a reed pen and liquid pigment, or ink. At Haltern in Westphalia, near the site of the Aliso fortress erected by Drusus in the year 11 B. C., was recently found a bronze vessel containing a dried black mass, which Prof. Kassner has decided to be Roman ink The mass was found to consist chiefly of soot and tannate of iron. It also contained smaller quantities of ferric oxide, copper oxide, clay, magnesia, gypsum, phosphoric acid, carbonic acid, alkalies, and sand. These ingredients probably represent chiefly accidental impurities which have found their way into the old inkstand, but some of them may be due to the chemical action of the ink on the bronze vessel. The presence of an aromatic substance suggests that the ink was imported from Italy, where the use of perfumed ink was common.

[illegible] for sale. The decor[illegible] the exhibition was [illegible]

[illegible] electric railway in Norway has [illegible] connecting Thamshaven and Lok[illegible] current from a hydraulic generating [illegible] Thamshaven, which generates three-phase current at [illegible] volts. This is converted into [illegible] current at [illegible] volts for use on the electric railway. The line was built for the purpose of [illegible] deposits in the region and for the convenience of tourists.

A [illegible] electric arc lamp has recently been designed, in which the carbons are formed out of plastic material in the lamp itself. The lamp is provided with [illegible] receptacles in which the plastic material is placed, and this is fed through tubes to form the two electrodes at the arc. The ends of the electrodes are [illegible] by means of electric heating coils, and the process is a continuous one. The gas generated as the material is heated is utilized to press the material into the electrode-forming tubes.

It is customary in Europe to place a netting under high-tension lines at railroads and important street crossings. As a further protection at such points, an inventor has recently devised a safety suspension in which the line is divided into three parts at the crossings and supported on three insulators, any one of which will bear the entire weight of the line at that point in case the others should be fused or broken. The German Post Office Department has approved of this system, and permits its use at crossings.

Governor's Island, New York, is to be provided with an electric fire-fighting plant. Heretofore there has been no apparatus for fighting fire except that carried by the small ferryboat that plies between the island and the Battery. Not long ago a fire took place while the boat was on its way to Manhattan, and before its return much damage was done. This demonstrated the necessity of providing the island with a fire engine of its own. The equipment that is to be installed consists of a turbine pump throwing a four-inch stream and operated by an electric motor.

The Canadian government has been petitioned to allow a Canadian power company to build a dam across the St. Lawrence River near Cornwall. This concern is associated with an American company It is their plan to dam the South Sault channel at first, to obtain 65,000 to 70,000 horse-power Later it is expected that a dam will be built across the main channel. This dam would not interfere with the Cornwall Canal. However, the plans provide for the building of a lock, through which at a single lift of 40 feet vessels could pass the rapids.

The work of extending the electric zone of the New York Central Railroad as far as North White Plains is proceeding quite rapidly, and it is expected that by the first of the year it will be in full operation. The temporary terminal at Wakefield, where steam and electric locomotives are interchanged, will then be abandoned. A new sub-station is being erected at Tuckahoe, and another one at White Plains. Each will be equipped with three 1,000-kilowatt rotary converters and nine single-phase transformers of 375 kilowatts capacity each.

Working on the theory that earthquakes are preceded by an electro-magnetic disturbance, an Italian scientist has devised an instrument which gives warning that an earthquake is about to occur a few minutes before the disturbance is felt. With this instrument the inventor, Padre [illegible], received warning of two earthquake shocks that occurred about ten miles from his laboratory four minutes before the [illegible] waves affected the seismograph. The instrument is connected to a clock, and is so arranged as to record the time elapsing between the arrival of the electro-magnetic waves and the seismic waves.

[illegible]

[illegible]

The United States Geological Survey reports that in 1908 California produced $1[illegible],761,859 in gold, 1,447,372 ounces of silver valued at $873,057, and 706 ounces of crude platinum valued at $12,414 This platinum was all produced at placer mines in Butte, Humboldt, Siskiyou, Trinity, Calaveras, Sacramento, and Del Norte counties, three-fourths of it having been mined in Butte County.

On the suggestion of Prof. Tissot, of France, an international commission has been organized for the purpose of transmitting wireless time signals from stations suitably located on coasts and islands to vessels navigating all waters. The establishment of this system would make the determination of longitude at sea very accurate and independent of the errors of the chronometer, which, indeed, would become superfluous. For transmitting the time signals Tissot recommends the wave length of 1,800 meters, or about 5,900 feet, which is used at the Eiffel tower station.

Eusapia Paladino, the Italian spiritualistic medium, who recently arrived in this country, has given some evidence of her powers. The phenomena of her first séance were the familiar physical phenomena of spiritualism. That is, they consisted of table rappings and levitations. Although considerable skepticism prevails as to the honesty of the medium, it must be admitted that she has not been latterly detected in fraud. Many years ago she was caught in petty tricks, which have by no means thrown her into discredit, because they seemed to have been due to involuntary actions in the trance condition Whether or not her more recent performances are genuine, we are not prepared to state. Certain it is, that her performances should be studied with scientific care.

Last year a small lot of shelled corn of a kind new to this country was sent to the Department of Agriculture from Shanghai It proved to have qualities that may make it valuable in breeding a corn adapted to the hot and dry conditions of the Southwest. The plants raised in the test averaged less than six feet in height, with an average of twelve green leaves at the time of tasseling The ears averaged 5½ inches in length and 4 1/2 inches in greatest circumference, with sixteen to eighteen rows of small grains. On the upper part of the plant the leaves are all on one side of the stalk, instead of being arranged in two rows on opposite sides. Besides this, the upper leaves stand erect instead of drooping, and the tips of the leaves are therefore above the top of the tassel The silks of the ear are produced at the point where the leaf blade is joined to the leaf sheath, and they appear before there is any sign of an ear except a slight swelling.

It is not an uncommon thing for corrosion and oxidation of bright steel objects to be caused by the presence of injurious substances in paper This may be due either to free acids or chlorine compounds, or more frequently, especially in the case of hard-sized paper, to the excessive use of aluminium sulphate, which is gradually dissociated by atmospheric influences Another drawback associated with certain kinds of paper is the blackening (due to formation of sulphide) which it produces on articles of silver or copper Owing to the growing use of paper of wood pulp prepared by digestion with sulphur compounds this blackening action is more prevalent now than formerly In fact, it is asserted by Herr Klemm in a recent investigation of this subject, that most, if not all, unbleached wood pulps of the sulphite and sulphate class contain traces of sulphur compounds that have a blackening action upon silver or copper, and that even bleached pulps may contain minute quantities of similar substances. Unbleached pulps prepared by the caustic soda process and mechanical wood pulps, however, are generally free from these sulphur compounds.

Capt. Roald Amundsen, the discoverer of the Northwest Passage, arrived in the United States recently Capt. Amundsen has come here to make preparations for an expedition to the Arctic which he calculated would keep him away from civilization probably more than five years. His primary object will be to explore the ocean depths of the region, to study the currents and temperatures and the character of the ocean bottoms. He will start from San Francisco in July, 1911, in the 400-ton gasoline auxiliary schooner "Fram," which was used by Nansen in his trip to the North. The Norwegian government has put up $20,000 for the expedition and there have been many private subscriptions from well-to-do Scandinavians interested in polar exploration and desirous of having their own people win the glory of discovery. Capt. Amundsen says his calculations in regard to the drift of the "Gjoa" were verified by events, and that he believes that the "Fram" will take the course that he is confident the drift will force her to take. He can assist in making that course pretty nearly across the pole by the use of his auxiliary engine at periods when the pack will permit him to move.

AERONAUTICS.

On October 23d, M. Bleriot made two flights with his aeroplane of 23½ and 17 minutes duration at Vienna. After the first flight he was presented to the Austrian Emperor, who was greatly interested in his machine. From Vienna M. Bleriot went to Bucharest, and made some flights before the King of Roumania.

Recognizing that in order to see flights by the daring French aviators substantial cash inducements must be offered, the people of Los Angeles, Cal., have raised $50,000 for prizes to be competed for by leading aviators of France and America at an aviation meeting to be held on the Pacific coast in January Paulhan, Delagrange, and several other of the French aviators have agreed to compete, according to cable dispatches.

Before leaving New York for their home in Dayton, Ohio, a few days ago, Orville and Wilbur Wright entered the French consul's office in New York late one afternoon and received from France's representative crosses and diplomas of the Legion of Honor Not until several days later did Miss Katharine Wright accidentally discover in one of her elder brother's pockets the decoration that is so much prized and sought after by distinguished men here and abroad. So engrossed was he in business relative to his aeroplanes that he had forgotten to mention it to his sister

The flying of model aeroplanes for prizes, which has been done almost weekly for some time past at the meetings of the Aeronautic Society has been taken up by quite a number of boys in New York city, who have made some excellent records at this interesting and instructive sport Contests are held weekly under the auspices of the West Side Y M. C. A., where Wilbur R. Kimball, E.E., is giving a course of lectures upon aeronautics. Cups have been given as prizes by Mr Louis R. Adams and by Mr Wilson Marshall, whose 12-year-old son, Wilson Marshall, Jr., has won two legs of the Adams trophy with a biplane model of the Wright type. Propelled by a rubber band motor, this model, the planes of which are about 2 feet long, covered 64 feet 9 inches in its longest flight.

Although Farman and Paulhan have quite frequently taken their wives on flights in their Farman biplanes, neither of these ladies has essayed to fly alone. It has remained for the Baroness de la Roche to become the first aviatress. After receiving several lessons from M Chateau, the instructor employed by the Voisin Frères at Chalons, the Baroness made a short initial flight of about 300 yards The following day this titled lady flew twice around the parade ground—a distance of about 4 miles—in a rather gusty wind. After the first few turns she was able to fly the machine without any trouble whatever, and seemed to have the biplane under perfect control This flight gave a good demonstration of fairly good automatic stability secured in the Voisin machine by the use of vertical partitions between the main surfaces and in the tail In America a Curtiss biplane is reported to have been sold to a wealthy lady in Florida.

The "Parseval III." airship, which has been at the Frankfort Aeronautical Exposition the past summer, made a grand tour above south Germany from October 12th to 16th, in the course of which it passed over Nuremberg, Augsburg, München, and Stuttgart. The 135 kilometers (83 8 miles) from Nuremberg to Augsburg *via* Treuchtlingen Mannheim, and Donauwörth was covered in 3¾ hours at an average speed of 22 1-3 miles an hour On the return journey in a straight line on October 14th, however, the airship is said to have covered about 37 miles in an hour This very much greater speed on the return journey was perhaps due to more favorable conditions and to the forcing of the airship at its limit of speed throughout the shorter distance That its speed is superior to that of the "Zeppelin" has been testified to by a well known American aviator who took a trip in the latter last summer and said that the "Parseval" readily passed it, although the "Zeppelin" airship made but 25 miles an hour according to his timing

Herr Hans Grade, the first German aviator to fly successfully with a monoplane of his own invention, and whose machine was shown in flight in our issue of October 23rd, has at last won the Lanz prize of $10,000 for the first kilometer flight by a German-built and piloted aeroplane. After first performing the required flight in 3 minutes 21 seconds above the Mars field at Bork on October 17th (besides which he made three other flights of 6 minutes 20 seconds, 48 seconds, and 2 minutes 20 seconds on the same day), Herr Grade took his monoplane to the aviation field at Johannisthal (where the flight for the prize was required to be made) and won the prize in short order on the 30th ultimo The following day he made three flights of 3¾, 14¼, and 5 minutes' duration respectively, and a fourth flight in which he made one circuit of the field. The motor used by Herr Grade is a 4-cylinder, V-type, air-cooled motor of his own invention which develops 24 horse-power and weighs 77 pounds. It makes 1,200 to 1,400 revolutions per minute and carries the propeller upon its crankshaft.

SALVAGE OF THE UNITED STATES CRUISER "YANKEE" BY COMPRESSED AIR.

The present attempt to raise the United States auxiliary cruiser Yankee is the first application to a United States warship of the method of salvage by compressed air used by Mr John Arbuckle The system has already proved its efficiency in the case of the raising of the steamship Bavarian of 12 000 tons after she had run upon the rocks in the St Lawrence River

In both the old system and the new the raising of a sunken vessel is accomplished by removing sufficient water from the hull of the ship to give the necessary buoyancy for flotation Under both methods the space within the ship that is rid of this water is filled with air but there is this important difference that under the ordinary method the air is at atmospheric pressure whereas under the Arbuckle method it is under a pressure equal to the depth of the hold or compartment from which the water is driven out

In raising ships it has been customary to send down divers who by means of patches of plating plugs wooden caissons cement etc attempted to patch up the hole in the hull and render the ship fairly tight When these repairs had been completed powerful pumps were installed upon the ship or upon wrecking vessels moored alongside and sufficient water was pumped out to lift the ship off the rocks and enable her to be towed to the nearest drydock

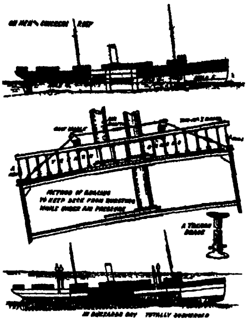
It frequently happened however that the perforations of the hull were so many or of such extent sometimes large portions of the bottom being torn entirely away that salvage by the pumping method was practically impossible This was due largely to the fact that the patchwork—plugs canvas cement and whatnot—was exposed to an inward pressure corresponding to the depth of the injured portion of the ship below water which pressure was so great as to exceed the resisting strength of the temporary repairs.

It occurred to Arbuckle a few years ago that there was no reason why the compressed air method as used in driving tunnels below the East and Hudson rivers should not prove effective in the salvage of sunken ships for if the mud silt and water can be held from entering the open end of a tunnel by opposing against it an air pressure equal to the water pressure at that level it seemed probable that the water could be expelled through the perforated bottom of a ship and held permanently at the level of this perforation by the same use of compressed air

Although it necessitates some exceedingly difficult engineering work and the exercise of considerable ingenuity the method by which the compressed air is used for freeing the ship of water is simple and easily understood No attempt is made to close the perforations in the bottom of the hull but great care is taken to render airtight the sides and roof of the various holds and compartments Air-supply pipes are led into the various compartments and compressed air is forced in and the water gradually expelled through the bottom until the level of the water in the various holds has been driven down to the highest point at which the hull has been perforated It is evident that as long as the air pressure is maintained the water cannot re-enter By estimating the capacity of the compartments thus treated and knowing the weight of the vessel it is possible to free the ship of the exact amount of water to bring her to the surface and make her float at some predetermined draft

The Yankee is one of four merchant ships built between 1890 and 1892 which were purchased during the war with Spain and transformed into auxiliary cruisers Latterly she has served as a torpedo supply ship She is 492 feet long 48 feet 4 inches in breadth and draws 20 feet of water on a displacement of 6 225 tons

In the autumn of 1908 she was run upon the Hen and Chickens Reef at the entrance to Buzzard's Bay and badly wrecked holds 1 2 3 and 4 being badly perforated as shown in the accompanying diagram. The Navy Department endeavored to float the ship by the customary method of closing the holds and pumping, but failing to get her off they abandoned their efforts and called for bids by private wrecking companies. The condition of the ship was generally considered to be hopeless and John Arbuckle was the only bidder Operations were commenced on October 21st, 1908. The berth deck throughout the whole length of the ship was made thoroughly watertight, and the water was driven out of holds 1, 2, 3, and 4 by compressed air, the engine and boiler rooms being emptied by pumping. The vessel was floated after forty five days of operations, and was being towed into New Bedford when, unfortunately the weather became very boisterous and a tug in going alongside the "Yankee" was driven against the portholes of the room containing the air-compressing machinery and stove them in and the water flooded the compartment and stopped the compressors The vessel slowly sank at a point one mile east of the Dumplings in Buzzard's Bay at the entrance to New Bedford Harbor and lay in the position shown in our various engravings The bow of the vessel was a few feet below the water but the stern lay thirty feet below the surface


ON HEN'S CHICKEN REEF
METHOD OF BRACING TO KEEP DECK FROM BURSTING WHILE UNDER AIR PRESSURE
A TRENCH BRACE
IN BUZZARDS BAY TOTALLY SUBMERGED

In the two diagrams of the "Yankee" the portions of the ship from which the water was expelled are shown in white

RAISING THE "YANKEE" BY COMPRESSED AIR

In the new salvage operations it was decided to leave the lower holds the engine and boiler rooms and the greater part of the gun deck full of water and lift the ship by expelling the water from the upper portion of hold No 1 from the whole of the berth deck and from the after portion of the gun deck Reference to the engravings will explain the conditions of flotation the unwatered areas being shown in white The first step was to make special steel hatches fasten them securely in place and calk them thoroughly watertight The gun deck being of steel was sufficiently watertight in itself but the after portion of the spar deck being of wood and having comparatively little resisting strength against the upward pressure of the air it became necessary to reinforce it strongly This was done by placing above the spar deck and upon the deck house a series of 10-inch I beams arranged in pairs, which extended the full width of the vessel. At its outer ends each pair of beams was anchored down to the waterway at the side of the ship by 2-inch iron rods set up with turnbuckles. Upon the beams immediately over the side walls of the deck house, two 12 x 12 timbers were placed parallel with the axis of the ship. Upon the outer [illegible] of these beams were set special cast-iron angle blocks, [illegible] each large [illegible] of 12-inch truss [illegible] carrying [illegible] to eyebolts which passed through the [illegible] the ship and were held in place by nuts. [illegible] under side of the I beam and the spar deck was [illegible] a number of trench braces which were set up [illegible] they bore snugly against the spar deck, thereby serving to transfer the upward pressure of the air to the system of trussed I beams as above described.

The special steel hatches were provided with openings to which were coupled five large steel standpipes, which extended above the surface of the water and were provided at their upper ends with air locks. The wrecking plant consists of a large schooner which is fitted up with living accommodations for the men; a big wrecking steamer upon which is installed a compressor plant capable of delivering 5,000 cubic feet of free air per minute a number of ship's boats, and a steam tug which makes regular trips between New Bedford and the scene of the wreck two miles out in Buzzard's Bay The difficulties of the work are greatly enhanced by the exposed position of the wreck, and there are necessarily many days when it is impossible to do any work.

These remarkable salvage operations have made excellent progress The sections of the ship to be unwatered have been made airtight the truss bridging over the spar deck is completed and it is expected that very shortly as soon as a favorable conjunction of wind and tides is presented the "Yankee" will be brought to the surface and towed into drydock Considering the great depth of water in which the ship lies her salvage will be one of the most remarkable feats of its kind in the history of wrecking operations.

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A GASOLINE ENGINE FOR CORN HUSKING.

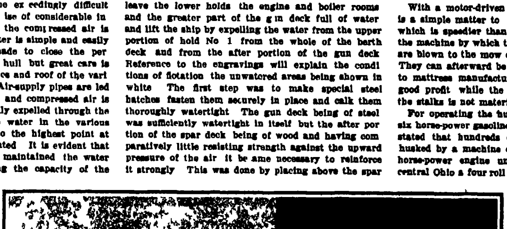
BY FRANK C PERKINS

At slight expense by the development of the gasoline motor the farmer is now enabled with modern labor-saving devices to do many times the amount of work formerly possible. The accompanying illustration shows the use of a small portable gasoline engine mounted on a simple four wheeled truck in operation just outside of the barn driving a corn husker by belt transmission

Thousands of acres of corn are not cut up but husked from the stalk thus entailing an entire loss except for the fertilizing value and a small amount of feed

With a motor-driven husker located at the barn it is a simple matter to "jerk" the stalk corn, a process which is speedier than husking and to shovel it into the machine by which the ears are husked The husks are blown to the mow or barge made of wire fencing They can afterward be baled and sold at a good price to mattress manufacturers the husk alone netting a good profit while the feeding or fertilizing value of the stalks is not materially lessened

For operating the husking machine only a four to six horse-power gasoline engine is required while it is stated that hundreds of bushels of corn have been husked by a machine of this type with only a three-horse-power engine under favorable conditions. In central Ohio a four roll machine has been able to husk 250 bushels in a day requiring four teams and one extra man besides the three men that operate the machine with a cash outlay of twenty five dollars per day It is stated that one of these small husking machines operated by a light gasoline engine will handle the same 250 bushels at less than half the expense or $11 50 This motor-driven husker is of the two-roll type, the rolls being four feet in length and large in diameter It runs at high speed, thereby greatly increasing the capacity, which is about 20 bushels per hour under normal conditions but has been operated at over 30 bushels without difficulty It is stated that the average run is from 7 to 10 shocks (12 hills square) per hour. The shredder head is composed of knives strung on a shaft 13/16 inch in diameter, held in position so that only one knife strikes at a time. The [illegible] [illegible] in fixed [illegible]. The [illegible] is [illegible] at the rear of the [illegible] so that all the stover must pass [illegible]

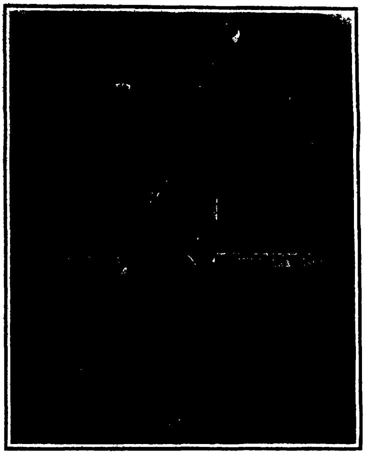


A GASOLINE ENGINE FOR CORN HUSKING.

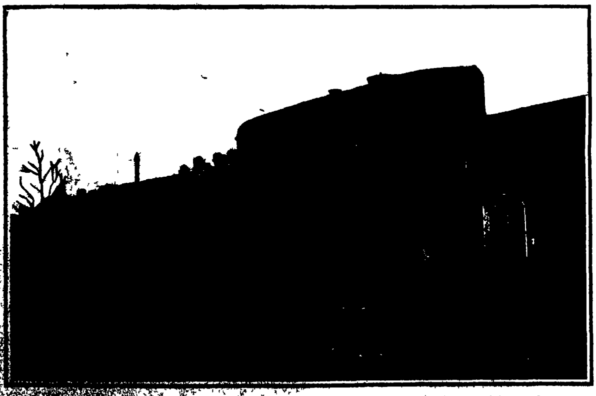
[illegible] for rendering the [illegible] carrying up to the machine [illegible] power is [illegible] as well as the [illegible] single movement of a lever attached to a [illegible]

THE GYROSCOPIC MONO-RAILROAD

In the spring of 1907, Mr. Louis Brennan, inventor of the Brennan torpedo, exhibited before the Royal Society of England a small car which traveled on a single rail or cableway, and kept its equilibrium perfectly even while rounding curves and when its load was shifted from one side to the other This feat, an apparent defiance of the laws of gravity, aroused a great deal of interest, and it was predicted that it marked a revolution in railroad practice. The car was kept in equilibrium by means of a pair of wheels, that were rotated at high speed in opposite directions. The gyroscopic effect of these rotating masses prevented the car from toppling over, in the same way that a top is kept from falling while spinning at high speed. Since the first exhibition of the gyroscopic car, Mr Brennan has been at work developing details, which would permit of using the same principle on a much larger car suitable for carrying heavy loads. A couple of weeks ago Mr Brennan's invention, now reduced to practical dimensions, was again exhibited before the Royal Society The car was 14 feet long, 13 feet high, and 10 feet wide, weighing 22 tons. Carrying a load of 40 passengers, the car traveled on a single rail around a circular track 220 yards in circumference. The balance was perfectly kept by means of two gyroscopes weighing three-quarters of a ton each and revolving at a speed of 3,000 revolutions per minute The wheels were incased and ran in a vacuum, so as to reduce friction to a minimum. A gasoline engine was used, to keep the gyroscopes spinning and also to propel the car The car was subjected to the severest of tests, the passengers suddenly shifting from one side to the other in their endeavor to destroy the equilibrium, but the gyroscope wheels responded to the slightest disturbance, and restored the balance at once One of the difficulties encountered in a car of this type is the precessional action accompanying the gyroscopic motion. This, however, was overcome by means of friction devices. The advantage of using a monorail is that the cost of construction is considerably less, but in addition to this there is the fact that a slight deviation from a true line would result in no damage, whereas when two parallel tracks are used they must both be kept perfectly parallel and in perfect alignment, otherwise the car will run off the track or will rock violently if one side dips below the other In other words, a double-rail track is more difficult to keep in repair than two monorails, for the reason that the two rails are interdependent, and variation in one must not take place without a corresponding variation in the other In rounding curves there is always danger of spreading the tracks when a double-rail track is used, while, with the monorail line, should the side thrust be sufficient to shift the rail, there would be no tendency for the car wheels to leave the track. As yet the details of Mr. Brennan's invention have not [illegible]



Mr. Louis Brennan standing in front of his gyroscopic monorail car



The [illegible] Brennan gyroscopic monorail car recently exhibited before the Royal Society, London.

THE GYROSCOPIC MONO-RAILROAD.

The Chemistry of Soldering Agents.

BY A. LIPPMANN.

The following summarizes the results of two years' practical experiments with soldering agents, chiefly those of the "soft" type which are suitable for electrical work, where it is necessary for the security of the service to keep within definite limits the resistance introduced and the heat generated at the points of junction. The requirements of mechanical strength, however, demand that the surfaces of contact of the wires shall be sufficiently extended to satisfy the condition of low electrical resistance, and when we consider that ordinary tin and lead solder has a specific resistance 10 or 12 times that of copper, it becomes evident that the chief function of the solder is not to conduct electricity but to protect and maintain the contacts of wire, and to preserve the copper surfaces from oxidation

There is a traditional belief that hydrochloric acid and other acid soldering liquids should not be used in electrical work, because acid left on the joint by a careless workman may, especially during the passage of a current, give rise to secondary electrolytic actions which will in time destroy the connection Investigation of many imperfectly soldered joints, however, has failed to indicate any injurious effect due to acids, and has revealed causes of very different character In most cases of large wires traversed by strong currents, insufficient contact had caused overheating of the joint and fusion of the solder In some instances the trouble was attributable to the formation of electric arcs between wires which were not held closely together by the solder

No injury due to the employment of acids could be detected even in resistance coils. With the fine wire used in these coils injuries are far more likely to be caused by careless handling (overheating or burning during the operation of soldering) than by acids.

These considerations lead me to form a lower estimate of the injurious action of acid soldering liquids than is commonly entertained The investigation in question was undertaken primarily to settle a dispute concerning the relative safety of two soldering liquids, of which one contained ammonium chloride and the other zinc chloride The difficulty of deciding the question had been increased by the circumstance that an injurious action had been attributed to the hydrochloric acid contained in both soldering agents

The first requirement for making a good connection by soldering is the presence of absolutely clean metal surfaces. If diluted hydrochloric acid is employed as a soldering liquid a good connection can be made between surfaces not originally quite clean Many coppersmiths use dilute hydrochloric acid exclusively in fine art work Experience shows that no injurious after effect need be feared if the soldered joints are well washed with water The notion that hydrochloric acid is difficult to remove is disproved by the great volatility of the acid. Ammonium chloride (sal ammoniac) is inferior as a flux to hydrochloric acid, and also to zinc chloride and zinc ammonium chloride

I made experiments in soldering with a preparation of ammonium chloride, to which ammonia was added drop by drop The efficiency of the soldering liquid visibly diminished as the proportion of ammonia increased Soda lye, added to neutralization, made the liquid entirely unfit for use Hence I attributed the good effect of ammonium chloride to the hydrochloric acid which is gradually separated in the operation of soldering Experiment showed, however, that ammonium chloride does exert an injurious action on copper When a mixture of ammonium chloride solution with glycerin was employed in soldering heavy copper cables to each other or to sockets, it was found almost impossible to prevent the liquid from penetrating between the wires of the cable I examined many such joints two weeks, three weeks, and six months after soldering In two weeks the wires of the core had become covered with a thick green coating of copper salt. I at first attributed the formation of this salt exclusively to the action of free hydrochloric acid but Samter has shown that ammonium salts possess a remarkable power of forming complex combinations with copper

Zinc chloride, zinc ammonium chloride and soldering soaps containing these salts may be regarded as the standard soldering agents. Zinc

(*Concluded on page 390*)

Census of Dirigibles and Aeroplanes.

The well known explorer and sportsman, the Prince Scipio Borghese, has presented to the Chamber of Deputies of Italy a tabulated statement showing the number of dirigibles and aeroplanes in existence in the world on September 30th. The former number 36; the latter, 76 In addition, 68 dirigibles are in course of construction The number of machines first cited are divided among the different countries as follows

	Dirigibles.	Aeroplanes.
France	9	27
United States	7	17
Germany	10	6
England	2	6
Belgium	1	5
Italy	3	2
Austria		5
Japan	1	3
Russia	2	1
Switzerland		2
Spain		2

The dirigibles are divided as follows into military and private ones.

	Military	Private.
Germany	7	2
France	4	5
United States	2	5
England	2	1
Italy	1	2
Russia	2	.
Belgium		1
Japan	1	.

The census of dirigibles under construction is as follows

	Military	Private.
Germany	8	7
France	5	10
United States	4	7
England	4	1
Italy	2	8
Russia	4	.
Japan	2	1
Belgium	1	2
Austria	1	2
Spain	2	
Switzerland	1	1

The number of aeroplanes which are known to exist are parceled among the different nations as follows:

France	27	Japan	3
United States	17	Switzerland	2
Germany	6	Italy	2
England	6	Spain	2
Austria	5	Russia	1
Belgium	5		

France, which possesses more than one-third of the aeroplanes in existence, is therefore considerably farther advanced than the other nations in this respect.

The *Life of the Infinitely Small.*

A few years ago Prof Metchnikoff ingeniously projected upon the screen the struggle of the red and the white corpuscles in the blood The spectacle was highly entertaining, but unfortunately lasted but a few seconds, for which reason the application of the process was exceedingly limited.

Thanks to a new apparatus recently devised by Dr. Comandon, and exhibited before the Academy of Sciences by Prof Dastre, the moving picture machine is made to give an enlarged view of the small microbes in activity Briefly stated, Comandon has devised a method of employing the ultramicroscope for the purpose of photographing microscopic life on a moving picture film.

The ultramicroscope, which has been more than once described in the columns of the SCIENTIFIC AMERICAN SUPPLEMENT, is not essentially different from any other microscope, except in the method of lighting the object to be utilized. In an ordinary microscope the light passes through a glass plate which supports the object, and thence travels to the eyepiece. Infinitely small objects are literally drowned in this brilliancy, and are therefore invisible. Their luminous intensity is not sufficiently different from that of the ambient light. With such an ordinary microscope it is impossible to study objects smaller in diameter than one-half a micron—a micron being equal to the thousandth part of a millimeter The ultramicroscope comprises the same arrangement of lenses as an ordinary microscope. Instead of illuminating the object from below and normally to the plane of the stage, the object is illuminated from the side or obliquely, so that the light rays fall only on the slightly elevated object, and therefore leave everything else in obscurity This result is obtained by a simple system of prisms and lenses.

Without entering into technical details, it may be said that with an ordinary microscope the eye is transported into a chamber bathed with sunlight. With the ultramicroscope the eye is transported to a dark room traversed by a single ray of light, so that it renders visible dust particles which otherwise would be invisible if the room were regularly illuminated Hence the ultramicroscope renders it possible to distinguish microscopic objects measuring not more than 1/100th of a micron in diameter, or 1/100,000th of a millimeter.

Comandon has succeeded in combining the ultramicroscope with the [illegible] to register upon a photographic film the life history of many infinitely small microbes. Among the more interesting films which were thrown upon the screen during Dr. Dastre's discourse before the Academy, was one showing the struggles of the white and the red corpuscles in the blood. The red corpuscles appeared as black globules outlined with white, and the white corpuscles appeared as white splashes. The picture of the corpuscles filed past at the rate of 960 a minute, each having been taken in about 1/32nd part of a second. The moving picture film views appeared on the screen magnified from 10,000 to 20,000 diameters. An inch seen under these conditions would seem about as high as a six-story house. The ultramicroscope moving-picture machine will undoubtedly render excellent service in biology, because it will register certain phenomena which at present cannot be studied.

It may be stated without in the least detracting from the work of Dr. Comandon that similar results have been already obtained by an English naturalist, Mr Mark Duncan. Furthermore, Mlle. Cheroton (the collaborator of Prof. Franck of the College de France) and M. Vlès have also chromophotographically studied the segmentation of sea urchins' eggs in the biological laboratory of Roscoff.

Ephemeris of Halley's Comet.

A letter has been received at Harvard Observatory from Father G M Searle, C.S.P., of New York, giving the following "Continued Ephemeris of Halley's Comet. T assumed to be Apr 19 d. 692 G. M. T"

EPHEMERIS.

Gr Mean Noon. 1909.		R. A. (1909.0) h.	m.	s.	Dec.	Deg.	Min.	Log. Δ	Br. (Sept. 11=1.)
December	1	4	27	54	+	15	58.9		
December	3	4	19	47	+	15	48.3	0.160	12
December	5	4	11	24	+	15	31.7		
December	7	4	2	50	+	15	19.0	0.148	13
December	9	3	54	8	+	15	5.0		
December	11	3	45	20	+	14	49.5	0.139	14
December	13	3	36	28	+	14	32.2		
December	15	3	27	35	+	14	15.2	0.134	15
December	17	3	18	45	+	13	57.8		
December	19	3	10	1	+	13	39.0	0.132	16
December	21	3	1	25	+	13	19.7		
December	23	2	52	58	+	13	0.1	0.134	17
December	25	2	44	45	+	12	40.4		
December	27	2	36	48	+	12	20.6	0.138	17
December	29	2	29	7	+	12	1.0		
December	31	2	21	41	+	11	41.9	0.145	18

Pseudo Blood Oranges.

It sometimes happens that a physician leaves absentmindedly in the tissues of his patient one of those fine needles which terminate the Pravaz syringe, be it by some wrong manipulation, or because of some awkward movement by the patient.

In such a case the treatment is very simple. One simply says nothing about it, and the patient does not notice it. The accident is of no consequence, the needle is not absorbed—of this there is no doubt—but proceeds leisurely through the tissues to some other point of the body

Unfortunately it is not so much that trouble may arise by this behavior of Pravaz needles, and that pain may be caused thereby, as it is that they may be brought about *secundum artem.* We find an example in the Presse Medicale

Blood oranges are often, it appears, "faked," at least in northern climes, where they command a higher price than the ordinary orange.

In order to transform these latter into blood oranges, certain "manufacturers" inject into the orange, through the rind, with the aid of a syringe provided with a fine needle, a solution of red aniline dye mixed with a saccharine solution. Now, recently, in St. Petersburg, a lady bought from a fruit merchant a dozen of these pseudo blood oranges. She gave one to her little daughter, but was distracted to find on putting the first piece into her mouth that she was attacked by a sharp pain in the region of the pharynx and spat blood. A physician being hurriedly called diagnosed the pain and hemorrhage as having been caused by a fragment of a needle which had lodged in the mucous membrane of the pharynx. When this fragment was extracted it proved to be a point of a Pravaz needle, in the eye of which was found a small remaining portion of aniline color

On returning to the orange dealer, he revealed that the "dodge" is often resorted to in manufacturing blood oranges.—Cosmos.

Wireless Telegraphy in the Antarctic.

The new expedition which is being fitted out in England to go to the South Pole, it is proposed to maintain in communication with the civilized world during the entire course of its exploration. Wireless telegraph apparatus will be installed on the "[illegible]," the ship of the expedition, which will serve as a base, and other apparatus will be carried by the different exploring parties, so that they can remain always in communication, more or less directly, with New Zealand.

[illegible] as an ore of radium, occurs in [illegible] States only in Gilpin County, Colo., where there are four mines that produce it. Carnotite occurs as a bright yellow powder in sandstones in Utah and Colorado.

Uranium minerals are radioactive, and their activity may be tested by their effect upon a photographic plate, which will show shadows of opaque objects placed between it and a specimen of uranium mineral.

Uranium has not yet been put to many practical uses. It is said to be used in steel making in Germany Uranium salts are used in iridescent glass and in pottery glazes, and uranium compounds are employed in chemistry and in medicine. A number of the uranium salts are violent poisons. Uranium and uranium salts were imported into the United States in 1908 to the value of $7,148, according to F. L. Hess, of the United States Geological Survey, whose report on uranium and other rare metals is published by the Survey as an advance chapter from "Mineral Resources of the United States, calendar year 1908."

Serviceability and Cleanliness of Alcohol.

Where the restrictions placed on the use of denatured alcohol are less stringent than those placed on the use of gasoline, or where safety and cleanliness are important requisites, the advantages to be gained by the use of alcohol engines in place of gasoline engines may overbalance a considerable increase in the fuel expense, especially if the cost of fuel is but a small portion of the total expense involved. Denatured alcohol will, however, probably not be much used for power purposes until it becomes as cheap as gasoline and until the equality of gasoline and alcohol engines in respect to adaptability to service required and quantity of fuel consumed per brake horse-power becomes more generally realized.

In regard to general cleanliness, such as absence of smoke and disagreeable odor, alcohol has many advantages over gasoline or kerosene as a fuel. The exhaust from an alcohol engine is never clouded with black or grayish smoke, as is the exhaust of a gasoline or kerosene engine when the combustion of the fuel is incomplete, and it is seldom, if ever, clouded with bluish smoke when a cylinder oil of too low a fire test is used or an excessive amount supplied. The odor of denatured alcohol and the exhaust gases from an alcohol engine are also not likely to be as obnoxious as the odor of gasoline and its products of combustion.

Wireless Telegraphy in Airships.

The German airship "Gross II." is provided with wireless telegraphic apparatus. According to newspaper accounts, good results have also been obtained with wireless apparatus on the "Zeppelin III." This announcement is especially gratifying, because doubts had been expressed concerning the advisability of attempting wireless communication with Zeppelin airships, on account of the danger of fire. The Zeppelin airship, unlike those of Parseval and Gross, has a metallic skeleton which is a good electrical conductor, and it is also exposed to the danger of an accumulation of an explosive mixture of gases in the space between the gas bags and the outer skin.

The Current Supplement.

An interesting aerial cableway and ore-handling plant in New Caledonia is described in the opening article of the current SUPPLEMENT, No. 1769. The desirability of fitting the farm dwelling with good plumbing fixtures and of installing a modern lighting system and economical heating appliances, is pointed out in an excellent article on the subject entitled "Plumbing the Farm House." Some simple practical inventions are enumerated—among them an automatic vulcanizer for automobile tires, a wrench with interchangeable disks, a wrench with tube for operating in corners, a [illegible] and [illegible]. A short but interesting article is that which describes a box with a secret drawer and recess. The Paris correspondent of the SCIENTIFIC AMERICAN contributes a description of Berjonneau's system of telephotography. Methods for making [illegible] are described and illustrated. The development of the [illegible] is [illegible] traced. Those interested in the history of Halley's comet will find in the current [illegible] a good ephemeris which gives the position of the comet up to December 28th. [illegible]

[illegible]RESPONDENCE.

[illegible] ARRANGING NUMBERS.

To the Editor of the SCIENTIFIC AMERICAN

[illegible] a long time your correspondence column [illegible] a lot of matter on magic squares Recently [illegible] came to my notice which is somewhat different from magic squares but which must surely be [illegible] by a system The problem is to arrange the numbers from 1 to 15 in seven different combinations of five rows and three numbers in each row so that no two numbers will be in the same row more than once. Of course, it is quite apparent that any number can be combined with seven different pairs but by what system can this or any similar problem be solved?

HERMAN S [illegible] Ph.D

New York city

CONTROLLING STEAMSHIP ENGINES FROM THE BRIDGE

To the Editor of the SCIENTIFIC AMERICAN

I noticed in a recent issue the suggestion by some reader of letting the engineers on ocean-going vessels and in fact all large steamers, see where they are going, and judge the speed for themselves, as when making a landing.

In this connection I would say that besides the troubles mentioned by you there would be the even more serious one of having two men each thinking separately, and each figuring on what to do without knowing what the other will do For example in case of an apparently impending collision the pilot sees that by making a quick turn he can avoid it. The engineer sees the situation and not figuring on the possibility of steering away backs his engine The result would be the vessel would not answer her helm quick enough with disastrous results

Now there is a system of control on a large number of motor boats, in fact on motor boats up to and including 75-footers called one-man control which is nothing more or less than bringing the engine controls to the steering wheel as on an automobile

Steering a very delicate operation is done by steam Why with a similar apparatus cannot a large vessel be made a "one-man control" boat? There is no great mechanical difficulty to it And what is more a steam engine could be entirely controlled by one lever whereas a gasoline motor takes three—reverse gear spark, and throttle

I would like to hear what others have to say on this subject.

H SUSSMAN

New York city

Some Curious Number Puzzles.

BY J F SPRINGER.

There are many curious things about numbers Some of these afford the basis for puzzling games To the uninitiated the results have a more or less wonderful appearance In the following article it is proposed to instance and explain certain of these puzzles The first is somewhat similar to a puzzle published by Mr W W R Ball The others are new and appear now for the first time

To begin with—there is the puzzle of the reversed digits A person is requested to select a number having in it an odd number of digits. He is next asked to reverse the order of the figures thus producing a second number Now he is directed to subtract the one number from the other and multiply the result by any number he pleases cutting off any naughts at the end Upon obtaining this he is to cross out the final two figures and tell you the resulting number He will probably be surprised to have you tell him the figures which he crossed out. You do this by annexing two naughts at the end of the number he tells divide by 99 and note the remainder This remainder subtracted from 99 yields the number crossed out by him.

Thus suppose the number chosen to be 48462 (an odd number of digits) Reversing this, we have 26484 Subtracting one from the other we obtain 21978 Multiplying this by 23 (any number will do) we get 505494. Crossing out the final two digits (94) we are supposed to be told the result—5054. To this we annex two naughts—505400. Dividing by 99 we get for remainder 5 Subtracting this from 99, we get the crossed-out number 94.

To understand the underlying reasons is not difficult. Thus, suppose the original number possessed, say, three figures. It can be represented algebraically by the expression $100x + 10y + z$, when x y and z represent the several digits. The reversal of this is [illegible] one from the other, we [illegible] which is evidently divisible [illegible] will still be true if we [illegible] The number then [illegible] and after [illegible] by 99. [illegible] divisibility by 99 [illegible] not able [illegible] the two crossed-out figures by naughts, we have a number which lacks something of being divisible by 99 or does not. In either case what needs to be added to bring the remainder up to 99 is the number crossed out If the remainder is naught then the number crossed out was 99 itself

Another puzzle where two figures are determined by the performer is the following A person is asked to select two prime numbers He is then to add them and square the result For a moment this is to be set aside Next the smaller of the primes is to be taken from the other and the resulting difference squared This last result is then to be subtracted from the result laid aside a moment ago You now request to be told the result. This you divide by 4 You will then obtain a number which can be factored in but one way yielding two prime numbers. These are the numbers selected at the outset

To illustrate suppose the prime numbers selected are 7 and 13. Adding and squaring you get 400 Subtracting and squaring there results 36 Subtracting this last number from 400 you have 364 Dividing this by 4 you obtain 91 This can be factored in but one way—7 × 13

To explain the matter algebraically let x and y represent the two prime numbers Adding and squaring we get $(x + y)^2$ Subtracting and squaring we have $(x - y)^2$ If now we write these expressions out in full and subtract the second from the first thus

$$(x^2 + 2xy + y^2) - (x^2 - 2xy + y^2)$$

we shall get $4xy$ This is the number told to the performer corresponding to 396 above Dividing by 4 we of course get just xy As both x and y are primes their product is factorable in just one way—into x and y

A third puzzle is when a person is requested to select a number He is then to square it and lay aside for a moment You then request that he take a number which is one less than the one selected and square this also He is now to subtract one square number from the other and tell you the result You then add one to the number he tells you and divide by 2 This will give you the original number

Again suppose that instead of subtracting one and then squaring your friend had been asked to subtract 2 and square You will then request the two squares to be subtracted the one from the other and the result communicated to you just as before You now add 4 and divide by 4 getting for result the number chosen

Thus in the first case if the number chosen were 13 the square would be 169 The square of one less than the number (13 — 1 = 12) would be 144 Subtracting 25 is obtained This is the number communicated to the performer Adding 1 and dividing by 2 we get 13—the original number

In the second case after squaring 13 and getting 169 we square 13 2 = 11 and get 121 Subtracting this from 169 we obtain 48 Adding 4 and dividing by 4 as directed we obtain 13

Algebraically considered we have for the first case $x^2 - (x - 1)^2$ as the number told to the performer This is really $2x - 1$ If we call this number N we have $N = 2x - 1$ Now N is known and we wish to get x

We have therefore $x = \frac{N + 1}{2}$

In the second case we have $x^2 - (x - 2)^2$ which yields $4x - 4$ Putting $N = 4x - 4$ we get

$$x = \frac{N + 4}{4}$$

Or to state the puzzle in a more general form we may request that the number to be subtracted be A instead of 1 or 2 as before We have then $x^2 - (x - A)^2$ This gives $2Ax - A^2$ Putting $N = 2Ax - A^2$ and solving for x we get $x = \frac{N + A^2}{2A}$ By using a formula such as this we may keep up the mystification by continually changing the number to be subtracted We have simply to remember that we add to the number told us the square of the number subtracted from the original number and then divide by twice this number (but without squaring) Thus if we tell the person to subtract 7 and then to square the result, at the end when he tells us the result of all his operations we have simply to add 49 (= 7^2) and divide by $2 \times 7 = 14$

Again, you request some one to square two consecutive numbers and add the results You then ask that he double this amount and subtract one You are then to be told the result. If he has performed his operations correctly this will be a perfect square You take the square root This will be the sum of the original consecutive numbers. By subtracting 1 and dividing by 2 you will determine the smaller The other one is of course obtained by adding 1

Thus, suppose your friend selects the consecutive numbers 11 and 12. Squaring and adding he gets 121 + 144 = 265. Doubling this and subtracting 1 he obtains 529. This is a perfect square it is the number he tells you. Taking the square-root you find it to be 23 Subtracting 1, and dividing by 2 you get 11 The original numbers are therefore 11 and 12.

To explain the matter algebraically we write $x^2 + (x + 1)^2$ as the sum of the squares of the consecutive numbers The next operation is expressed thus $2[x^2 + (x + 1)^2] - 1$. This gives $4x^2 + 4x + 1$ This is the number told the performer and should be a perfect square It is In fact it is equal to $(2x + 1)^2$ Subtracting 1 from the square root the result is $2x$ Dividing by 2 the smaller of the two consecutive numbers is obtained

Still another puzzle consists in the following procedure You ask the "patient to select a number of any number of digits He is then to form with the same digits a second number by rearranging the digits in any way agreeable to himself These two numbers are then to be subtracted the one from the other and the result multiplied by 33 You now request that any naughts that may be at the right hand end be cut off He is then to cross out the final pair of digits and tell you the number remaining after this is done You annex two naughts divide by 99 and subtract the remainder from 99 The result will be the figures crossed out

This puzzle depends for its success upon the fact that when two numbers formed of precisely the same digits but differently arranged yield upon the one being subtracted from the other a new number divisible by 9 Upon multiplying this by 33 it will still be so divisible and will in addition contain 11 as a factor In consequence of containing 9 and 11 as factors it will contain 99 (= 9 × 11) as a factor The explanation of the remaining procedure is the same as that given in the case of a preceding puzzle That two numbers having the same digits but differently arranged will yield a number divisible by 9 may be seen by considering the following equations

$$10000w + 1000x + 10y + z - (10000y + 1000x + 100z + w) = 9999w - 9990y - 99z = 9(1111w - 1110y - 11z)$$

To illustrate this puzzle suppose the number selected is 46309 Rearranging the digits we get say 60349 Subtracting 46309 from 60349 we get 14040 We now multiply by 33 and get 463320 Observing that this has a naught at the right hand end we cut it off obtaining 46332 We now cross out the 32 and get 463 as the number which would be told to the performer He annexes two naughts and gets 46300 This he divides by 99 obtaining 67 for the remainder He subtracts this from 99 and gets 32 the number crossed out

◆

A New Fare Box for Pay-as-You-Enter Cars

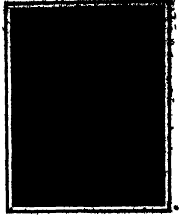
A new fare box for pay as you-enter cars has made its appearance in New York It differs in almost every way from the usual contrivances of its kind In the first place it not only collects and registers nickels but gives the conductor access to the cash after it has been registered and this renders it unnecessary for him to fill his pockets with change before he starts out on his trip In the second place the new fare box enables the conductor to detect mutilated and counterfeit money for the coin slides down a glass covered chute and is therefore visible If the conductor discovers that it is a counterfeit the coin is mechanically dropped into a special receptacle and returned to the passenger If the coin is good it is registered and caused to drop into a cash drawer Although it is not likely that a dishonest conductor would attempt to abstract so small a sum as a nickel by turning the box upside down so that the nickel would run out an automatic gravity closure has been provided which effectually blocks the chute if the attempt should be made so that the fare must pass through the apparatus in the regular way The width of the chute is just large enough to accommodate a good nickel A larger coin cannot enter and a smaller coin is mechanically returned by the machine Each conductor is held responsible for the fares registered Although he has access to the cash collected the amount turned in must be the amount recorded Thus a very simple and effective check is provided without the necessity of giving the conductor a large amount of small change with which to start his trip The boxes are made of a special composition of metals and weigh only 10 pounds

◆

Peat fuel will be used in an electric station being erected in Germany The new plant is being installed in the region to the southwest of Oldenburg and it lies in the vicinity of extensive peat fields from which the supply is to be secured The electric plant is laid out on a large scale and when completed it will be one of the largest in the country It is to furnish current over a network of power lines which will cover the entire Duchy of Oldenburg with a radius of 40 miles Probably the new station will be completed about the end of next year and in the meantime measures are being taken to find out about what amount of power will be taken in the various cities and towns within the area.

SOUNDING THE OCEAN OF AIR ABOVE US.

ATMOSPHERIC EXPLORATION



The science of meteorology has so far progressed that we know with considerable accuracy the nature composition and general properties of the lower air If meteorology is to become anything like an exact science in other words if we are to predict the weather not only of tomorrow but even of next week with more accuracy than is now possible we must have at our disposal data which will enable us to determine the condition of the upper layers as well and their effect upon the lower layers In the interest of that investigation we find that the modern meteorologist has been conducting for the last two decades investigations that will sooner or later bring together an enormous mass of facts which the mind of some master meteorologist will some day whip into a scientific correlation

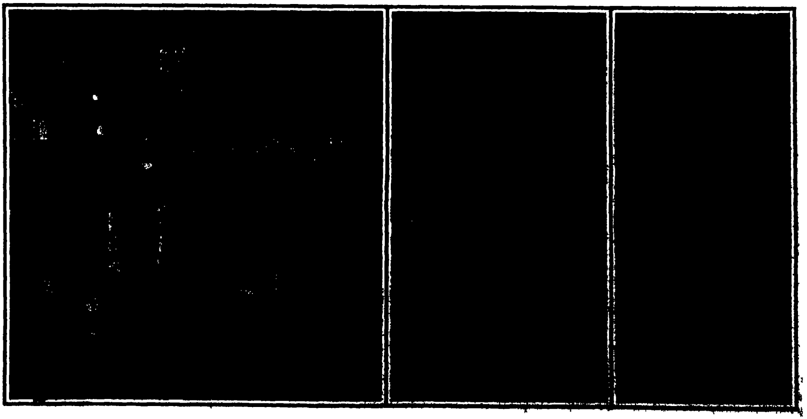
In this effort to discover the physical attributes of the upper layers of the air barometers hygrometers thermometers and wind gages are employed The barometer measures the weight of the air the hygrometer its moisture the thermometer its heat the wind gage its velocity These instruments all of them well known in meteorological research have been considerably modified for the study of the upper air a modification necessary because they must be lifted to great heights by means which make it impossible to employ great weights Hence it is that they are made of feathery lightness and are ingeniously combined The combination is usually known as a meteorograph Thus the thermometer and barometer are merged into a meteorograph specifically known as a baromethermograph a contrivance which is provided with two automatic styles one of which writes down the pressure of the air and the other its varying temperature Sometimes the barometer thermometer and hygrometer are joined in a single instrument which notes the humidity as well as the pressure and temperature The records are made upon clock driven cylinders covered with lamp black because no ink has been found which will not freeze in the bitter cold of the upper air At lower levels special inks and paper can be employed The construction of these meteorographs has involved not a little ingenuity Perhaps the men who have contributed most in devising special forms of instruments are Mr S P Fergusson and Mr H H Clayton of the Blue Hill Meteorological Observatory in this country

Fifty years ago the experiment was made of intrusting instruments of precision to venturesome balloonists Because a human being cannot live in the thin air of great altitudes these experiments sometimes proved fatal Hence it is that the meteorologist has adopted in a measure the methods of the marine biologist In other words he sounds the ocean of air at the bottom of which we live

His sounding methods are dependent upon the employment of kites and free unmanned balloons By their means it has become possible to elevate the delicate instruments which automatically record the physical condition of the upper air and to bring to the earth an accurate account of atmospheric happenings many miles above the earth's surface The men to whom most of the credit for this new means of investigation is due are Prof A Lawrence Rotch of the Blue Hill Meteorological Observatory in this country Dr Richard Assmann of Germany and Teisserenc de Bort of France

The exploration of the upper air by kites has been carried to the greatest perfection by Prof Rotch It may safely be said that his study of the lower four miles of air is the most complete that has yet been made The kites employed by him and for that matter by almost every meteorologist—are of the open box type invented by Mr Lawrence Hargrave The kites often measure 9 feet in length Such is the pull exerted by them that it is impossible to employ muscular power to control them For that reason they are hauled in by engine driven winches Devices are employed which register the pull of the kite and the length of the line in use Often it happens that as much as ten miles of line may be paid out In spite of the great lifting capacity of such a kite it could not attain any considerable height if it were held by hemp alone A cord or rope would necessarily be so heavy and thick that a kite would be severely taxed in pulling it up Hence it is common to employ fine music wire which is both strong and light. The elevation attained by a kite is determined in fair weather by means of theodolites. At night and in hazy weather the meteorograph readings themselves must be depended upon

Four miles may be considered the maximum height that a kite is capable of attaining To sound the reaches of air above that level, the free or unmanned balloon is employed of which the most skillful use has been made by Teisserenc de Bort and by Dr Richard Assmann These free balloons are filled with pure hydrogen gas which expands with increasing elevation Since the degree of inflation obviously depends upon the height to be attained considerable care must be taken not to fill the gas bag entirely If the balloon is to reach a point where the air is one-half as dense as at the level of the sea the gas bag is filled about one-half If a height is to be attained at which the air density is one-fourth that at the level of the sea the bag is filled about one-fourth. It is very evident that for the attainment of very great heights the balloon's capacity must be great and the construction exceedingly light This explains why instruments of feathery lightness must be employed Originally fairly large paper balloons were employed for the purpose by Teisserenc de Bort but the India-rubber balloons of Assmann have now taken their place These India rubber balloons vary in diameter from three to five feet They have reached considerable heights At the maximum elevation of the balloon the expansion of the hydrogen gas eventually bursts the bag In order that the instruments may not be dropped precipitously to the ground they are checked in their descent by a parachute Instead of a parachute a slightly inflated auxiliary balloon may be employed which does not explode and which has sufficient buoyancy to prevent a too rapid fall of the instrument Recently S Saul of Aachen Germany has advocated the use of two balloons connected by an aluminium pipe provided with a valve The weight of this pipe is much less than the netting generally applied to the balloon to carry the basket containing the recording instruments and is certainly much lighter than a para



Inflating a Saul double balloon. One balloon inflated. Both inflated.

The Saul double registering balloon.

SOUNDING THE OCEAN OF AIR.

[illegible] The arrangement is such that when the double balloon reaches its maximum height, the one bursts, and the other, not having sufficient buoyancy to carry the whole weight of the apparatus sinks slowly to the earth At the same time it serves to attract the attention of the finder because it floats a few feet above the ground. The balloons can be filled in the open air, even in windy weather by one man whereas special care must be taken with the ordinary system

To every basket in which the instruments of a sounding balloon are contained, a printed notice is attached which offers a reward for their return A very large number of the instruments which drop to the earth thus find their way back to the observatories

Sounding balloons reach astonishing elevations and travel at speeds varying from 40 to 80 miles an hour

Although a large number of *ballons-sondes* were dispatched from St. Louis in 1904-7 under the direction of Prof Rotch, none had been employed in the eastern States until last year In May and July 1908 four *ballons sondes* were launched from Pittsfield Mass with special precautions to limit the time they remained in the air and so prevent them from drifting out to sea with the upper westerly wind Three of the registering instruments have been returned to the Blue Hill Observatory with good records The first instrument sent up on May 7th was not found for ten months and the record is very interesting because it gives complete temperature data from the ground up to 17 700 meters or 11 miles This is 610 meters higher than the highest ascension from S Louis which by a coincidence was also the first one to be made there On May 7th a general storm prevailed, so that the balloon traveling from the east was soon lost in the cloud and its subsequent drift could not be followed but the resultant course was 59 miles from the southwest as determined by the place where the instrument fell two hours later A paper balloon will reach its greatest height in about six hours a rubber balloon in three hours

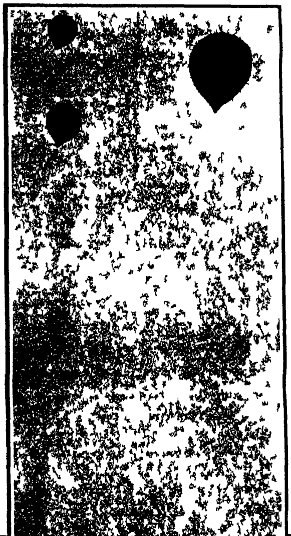
The air-exploring stations of the entire world have banded themselves into an association for the purpose of carrying on a systematic exploration of the upper air on agreed dates Thus we find that each year an international week of exploration takes place in addition to the regular work of each observatory These international weeks may fall in the spring sum

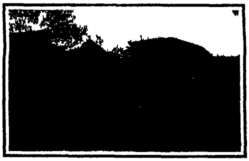
(Continued on page 3 9)

Sending up a pilot balloon.

Preparing for a balloon ascent.

A balloon ascent on Lake Victoria Nyanza.





A kite ascent on Lake Victoria Nyanza.

One of the box kites used

Controlling a kite with a hand windlass

Fixing the course of pilot balloons with special theodolites. The pilot balloons are liberated to ascertain the direction and velocity of the wind before the liberation of registering balloons.

GERMAN METEOROLOGICAL INVESTIGATIONS IN EAST AFRICA.

A SELF-ACTING MAIL ELEVATOR.

BY THE BERLIN CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The present methods of mail delivery in hotels, apartments, and office buildings are defective in many respects The letters and parcels are delivered to each lodger of an apartment house by hand, which obviously means waste of time and energy The system prevalent in some countries of handing all the mail matter to the doorkeeper or porter, to whom is left the care of distributing it to the various addresses, is also objectionable Nor can the letter boxes installed at the house door be called practical in all respects.

The idea of using the elevator principle for doing away with these drawbacks seems so simple, as to make one wonder that it should not have been long ago carried into practice As it is, a Berlin engineer, Mr E F Ostrowsky, has been the first to utilize it for the delivery of mail matter His system is of remarkable ingenuity and simplicity

One of our views shows a perspective of the mail elevator as designed for three stories of two tenants each Another view is a lateral section of the elevator A letter box installed on each staircase landing, and a façade, with a built in elevator, are also illustrated

The construction of the apparatus is based on a very simple mechanical principle.

In a narrow vertical shaft moves a frame *A* suspended by a wire rope, one end of which is fastened to the top of the frame *A*, whereas the other end passes over rollers *L*, and sideways, downward around the drums *G* and over another roller and opening in a board above the drum The end of the rope is fastened to a coiled spring which is connected with the lower part *B* of the frame *A* and imparting resiliency to the rope.

Because of this arrangement, the frame *A* can obviously be moved upward and downward, by means of the crank *H* and the drum *G*

In the frame *A* a letter box *M* divided into two equal parts is swiveled. The box has two apertures in both the front and back.

The rear wall of the elevator shaft is provided with openings communicating with the backs of letter boxes at the several stories. The openings are provided each with a hinged cover *C* opened by means of the levers F^1, F^2, F^3, connected with vertical rods.

The entire elevator shaft can be built directly into the vestibule floor in the case of new buildings as shown. Its external appearance can be made to resemble a column, in the case of existing houses. After dropping the mail matter into the proper compartment of the letter box *M* provided with special labels for each of the lodgers, according as the addressee lives in the left hand or right-hand wing of the house, the postman will lift the lever *F* corresponding to the story in question, thus opening through the medium of the lever *D* the gate *C* When the letter box *M* is lifted by turning the crank *H* at the high speed resulting from the considerable diameter of the pulley, it strikes against the open gate *C*, and, being tilted, pours out its contents automatically into the letter box, arranged on the staircase landing

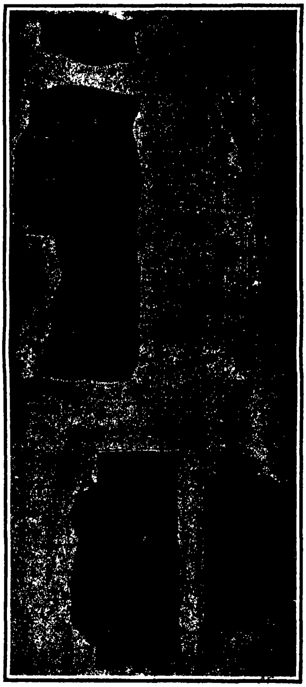
As the gate *C* is opened, it strikes against the bell *K*, thus announcing the arrival of the mail An indicator on the receiving box is employed for the same purpose, the indicator remaining in a visible position until the letter box *M* has been emptied As the crank is turned backward the letter box is brought down to its original position

* * *

At the Fifth International Geographical Congress, held at Bern in 1891, Prof Albrecht Penck, the well known geographer, proposed that the enlightened nations who were engaged in making maps of their own territory and of other countries should unite upon a common plan for the preparation of a general map of the world. He suggested that the scale of the map should be 1 1,000,000, or about 16 miles to the inch and that the separate sheets of the map should be so bounded by meridians and parallels that any two sheets representing adjacent areas should match except for distortion of projection, no matter by what country either sheet might be made This proposal led to resolutions and discussions at subsequent geographic congresses and to the preparation of several tentative maps by Germany, France, England, and the United States, in conformity with the general plan proposed by Prof. Penck.

* * *

The Russian Minister of War has undertaken to establish, by a succession of wireless telegraph stations, telegraphic communication between St. Petersburg and the far East.



A MAIL DELIVERY SYSTEM FOR APARTMENT HOUSES AND OFFICE BUILDINGS.

Treatment of Diseases of the Eye by Means of Intermittent X-Rays.

BY DR. A. [illegible]

It is to Cook of New York that we owe a new method of utilizing the Roentgen rays. The field for the usage of these rays seems to be unlimited; apparently, they will eventually prove to be of great therapeutic value for the various diseases of the eye. Possibly, even, if these rays are judiciously applied at the inception of infections which are supposed to be incurable we may thereby avert total loss of eyesight.

Let us first consider the production of intermittent X-rays, or, as they have been called by Dr David H. Coover, of Denver, U S. A., "the sparks of Roentgen rays." The apparatus specially in mind consists of a small motor, a condenser, and a movable scale.

My arrangement differs a little from that of Coover. It consists of a clockwork movement actuating a graduated rod provided with a movable screen. The rod is placed behind the localiser, and according to the position of the screen upon the rod, the interruptions follow one another more or less rapidly at the rate of from 50 to 200 per minute.

With the aid of a regulator, one is able to obtain from 40 to 600 sparks per minute. The amperage and the distance of the tube are likewise carefully regulated. Experience has demonstrated that the best results are obtained in ocular affections by a somewhat restricted number of sparks, 75 to 150 per minute, and by removing the eye to a distance of about 27 centimeters from the focus.

It develops that radiant energy possesses four distinct therapeutic properties, namely, sedative, stimulating, irritating, and sloughing functions, each of which corresponds to an electrical, mechanical, chemical, and calorific effect.

With the intermittent rays it has been possible to separate the purely stimulating action from the irritative action, and experience has demonstrated that by thus proceeding, the regenerative action is enhanced.

Cook has [illegible] of the [illegible] mittent rays found its [illegible] in the [illegible] of affections of the eye." If a cataract which [illegible] mature is exposed to continuous rays and [illegible] stimulations, an improvement of the eyesight is [illegible] or later followed by a maturation of the cataract, as a consequence of hyper-stimulation or irritation. This fact permits the establishment of a technical rule for the maturation of incomplete cataract. With the "sparks," especially when higher amperage is used, the irritation and the maturation are avoided; and with an incipient cataract the stimulations and regenerating effect are not only invariably obtained with more or less improvement in eyesight, but may be maintained during the entire treatment.

Dr. Coover may not have experimented with incipient cataract, but he has at least observed the regenerative action in other affections of the eye. In a case of serpiginous ulcer of the cornea new cells were rapidly formed, and a cure was effected only by application of the intermittent rays.

In the opaque portions of the cornea, the process of absorption results in a hyperemia of the blood vessels of the eye, as has been found in all cases which have undergone treatment.

The vessels of the conjunctiva are more congested after each treatment. The hyperemia persists for several minutes, and if there was previously a peri-corneous injection, it is always enhanced. Examination, by means of the ophthalmoscope, of the ball of the eye, after having been exposed to the rays, always shows an increase in the size of the vessel of the retina, particularly after a case of optical atrophy

The regeneration is accompanied by diminution of the tension, improvement of the circulation, and increase of the leucocytes. These modifications are noticeable in the muscular, nervous, osseous, vascular, epithelial, and glandular tissues.

The action manifests itself in the eye on the optic nerve, the cornea, the crystalline lens, the charoid, the retina, and the iris. In addition to the local effect, there is found another of a more particularly tonic nature. The cellular metabolism increases, and all the vital processes are stimulated, a condition which is necessary for the treatment of all local degenerations.

This effect, evidently, is totally different from that produced by continuous rays, which have a regenerative effect only during the early stages of their application This effect is particularly noticeable in the blood. At the start there is an increase in the number of red and white corpuscles, particularly the latter, and later, degeneration sets in, as is indicated by a diminution in the number of these corpuscles.

Some observations have been published regarding the cure of blindness and deafness by prolonged treatment with continuous rays employed for the treatment of cancer having its seat near the eye or the ear

Prof. Birch Hirschfeld of Leipzig has reported the anatomical modifications of an eyeball exposed to prolonged radiations during the treatment of a carcinoma (cancer) of the temple by the X rays. The principal troubles were due to the endothelium and to the vacuolization of the structures of the iris and of the retina. The macular region was the one most affected, and the seat of a cellular degeneration. There were no symptoms of inflammation. Experiments upon an animal led to the same conclusions. By his experiments with rabbits, Selenkowsky has likewise demonstrated the danger of immoderate or unskilful use of continuous X-rays. This degenerative action of X-rays was likewise observed by me some years ago, and treatment of various cases led me to the same results as those of Cook. Having treated with the X-rays a woman forty-five years of age for a leucoma of the cornea complicated by incipient cataract, I was surprised to obtain a very appreciable improvement in the condition of the cornea, and likewise in the condition of the crystalline lens; but, in the measure in which the clearing up of the cornea was effected, an equally rapid development of the cataract occurred, so that it was soon completely operable. Enlightened by this experience regarding the peculiar effects of continuous rays, I have used much restraint in treating cases by this method, and have never subjected my patients to a repeated treatment with X-rays. The technical details of the process of Cook and Dr. Coover seem to be rational, and the observations of the latter lead me to look confidently into the future regarding affections as serious even as optical atrophy.

It seems that in the acute, [illegible]

(Continued on page [illegible].)

POROSITY OF LIQUIDS.

BY A. S. VAN DER VEER.

It is rather difficult to imagine liquids as having pores, though this seems to be the case as shown by certain familiar experiments. When a certain amount of powdered sugar is slowly poured into warm water, the water will dissolve the sugar and appear to absorb it without increasing its volume. Similarly, when alcohol is poured into water, the resulting volume will be less than the sum of the two volumes

ALCOHOL "SOAKING" INTO WATER.

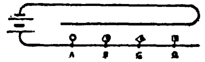
For instance, if fifty parts of water and fifty parts of alcohol be mixed together, they will make only ninety-four parts. Apparently one of the liquids has entered into the "pores" of the other This experiment as commonly performed in physics laboratories consists in putting measured quantities of the two liquids together, but the effect would be far more striking were it possible for students to see one of the liquids actually 'soaking" into the other This can be done in the following way Take two glasses, one filled to the brim with water, and the other with alcohol. In order to show the effect to better advantage, color the alcohol with red ink. The glasses should not be over-full, that is, the surface of the liquid should not bulge above the rim of the glass. When everything is ready, place a sheet of paper over the glass full of alcohol, and with a hand on the paper to keep it down on the rim of the glass invert the tumbler, and the liquid will remain in the glass, owing to the air pressure on the paper Now place the inverted tumbler over the glass full of water, and carefully draw out the paper This can be done without spilling a drop of alcohol, and yet as soon as the paper is removed, the alcohol will commence to drop. Owing to the fact that it is colored, it is possible to see the alcohol actually "soaking" into the water, while tiny air bubbles that were formerly contained in the "pores" of the water rise slowly to the top of the tumbler This will continue for some little time until a considerable air space forms in the top of the tumbler.

INVERTING THE GLASS FULL OF ALCOHOL.

PLATING SPOONS AND FORKS AT HOME.

BY A. J. FARMAN.

In the home of every handy man there are generally some forks or spoons that have become somewhat the worse from wear. Every such article if in a moderately good condition is worth replating, and if the work be done at home as much silver can be deposited as one desires, so as to give a coating that will last for years. The following directions will enable any handy man to silverplate his own goods in a very satisfactory manner, with such silver as there happens to be about the house, such as an old silver watch case, a badly worn solid silver [illegible] or two, or an [illegible] [illegible] so that any old [illegible] of silver [illegible] [illegible]. Of course, [illegible] this commodity [illegible] [illegible] [illegible] an ounce and a half of pure granulated silver at about sixty cents per ounce. Assuming that the old silver mentioned is to be had, proceed as follows. Procure a small stoneware pot of about one or two quarts capacity Weigh the silver—there should be about two ounces. If there are any iron or steel rivets or rings about the watch case, or any German silver parts, break them off with a pair of pliers. Place the silver in the crock, pour upon this four or five ounces of nitric acid (chemically pure) of a strength known as 38 deg. Place the crock into an enameled tray Pour some hot water into the tray, to aid the chemical action Place a sheet of glass upon the pot, or a stoneware lid if it is provided with one, then stand the pot out of doors, because the fumes that are given off are poisonous In the course of half an hour, all the silver will have become dissolved Now fill the pot half full of cold water, to dilute the nitrate of silver that has been formed. The liquid will present a bluish green appearance, due to the copper contained in the old silver articles. Take four ounces of hydrochloric acid, and add to it four ounces of water Then pour this into the silver solution. Stir vigorously while this is being added, with a clean glass strip. The silver will now be thrown down as chloride of silver, in the form of a dense white precipitate Let this stand for about two hours, to allow the chloride of silver to become precipitated, carefully pour off the clear bluish green liquid, without disturbing the precipitate. Fill the pot again with clean water, stir well, and let it subside again for a couple of hours Repeat this four times This operation will free the chloride of silver of the dissolved copper, also the result of chemical decomposition. *If pure granulated silver is used proceed* in the same way, only in this case there will be no copper impurities to be gotten rid of Procure a three-gallon crock, with plain upright sides, pour the chloride of silver into this, wash out every scrap of chloride Pour these washings into the crock, then dissolve half a pound of cyanide of potassium in the jar that the silver was dissolved in The cyanide must be that known as 99 per cent commercial three pints of water being used When completely dissolved, pour this upon the chloride of silver keeping in reserve about half a pint of the cyanide solution, stir the mixture with a glass strip wait a short time, and then, if the chloride has not become completely dissolved, add a little more cyanide solution When the chloride is completely dissolved add not more than four ounces of the cyanide solution, this will give what is known as free cyanide Add a quart of water, *stir and allow this liquid to stand twenty-four hours.* This will allow any dirt, also a small portion of carbon from the cyanide, to subside. Very carefully pour off the clear liquid, drain this off, return the clear liquid to the crock. After rinsing the crock out make the quantity of liquid up to two and a half gallons This is the silver-plating fluid



CONNECTIONS FOR AN OBLONG PLATING TANK.

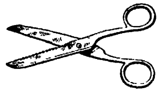
A two-cell Fuller mercury bichromate battery will be just the thing for plating. Take a stout piece of copper wire, bend it in the form of a ring, so as to extend around the crock of the plating liquid, resting upon two strips of wood, obtain about one ounce and a half of pure silver and solder a piece of No. 16 insulated copper wire to it Attach this to the carbon of the battery, let it dip into the center of the plating crock, also procure some finer copper wire No 22 gage cut this into strips six inches long. Now take the forks and spoons, file down any badly worn parts, finish them off with some fine emery cloth glued to a flat strip of wood, and boil the lot in a saucepan with some strong washing soda and water to remove all grease. Scrub the fork or spoon with a fine-cut nail brush dipped into pumice powder, also wet the fingers and dip them into the pumice powder, so as to prevent any grease from coming into contact with the article. Scour the article well, twist one of the pieces of fine copper wire around the middle of the spoon, dip this into clean water, then quickly dip again into a solution of nitrate of mercury (one ounce of nitrate of mercury in one gallon of water) Rinse it again quickly in clean water, and place it at once into the plating liquid, suspending it from the ring of copper wire around the crock, which must be connected with the zinc of the battery About a dozen spoons or forks can be treated in this way the silver will take to the article at once. The sole use of the nitrate of mercury solution is to insure a perfectly clean surface, in fact chemically clean, which causes the silver to adhere firmly to the article As soon as six or seven articles have been placed into the plating bath they must be removed and brushed well all over with a brass-wire scratch brush, known as a hand scratch brush, which can be bought, with two rows of brass wire, for 35 cents. The article when so brushed must be returned to the plating bath to receive a further deposit, which may last for an hour or more according to the quantity of silver it is wished to put on To determine the quantity deposited first weigh the silver plate, called the anode when if at the end of one hour the loss has been 130 grains it will be known that 130 grains has been deposited upon the twelve forks or spoons. The articles must be removed every half hour and be scratch brushed This will rub down the white burn, as it is called, giving an even, smooth deposit.

When all the articles have been plated and scratch brushed wipe them clean and burnish them by the use of a small steel burnisher or, if this cannot be obtained, use a very smooth and bright shoemaker's awl Hold the article with a clean cloth dip the awl or burnisher into a little soap and water stroke this carefully, with moderate pressure, up and down the spoon handle, and blend by continuing the stroking Then rub carefully over the back of the bowl while the curved part of the awl can be used to rub the inside of the bowl. *Of course a little care* is necessary not to cut or abrade the deposited silver Polish the article with a piece of chamois leather dipped into fine rouge, moistened slightly, and finish off with a clean chamois leather, It is important that the circuits through the several articles have the same resistance otherwise more silver would be deposited on one than on the other The diagram shows how this is accomplished when an oblong tank is used The circuits through *A B C* and *D* are all of the same length

SCISSORS WITH A SAW-TOOTH.

BY W J C

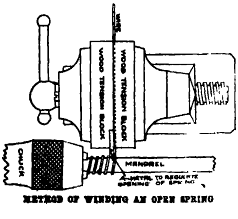
A very handy tool can be made from an old pair of scissors or shears as shown in the accompanying sketch One blade is cut with a set of saw teeth inclined toward the handle These teeth hold the material fast, and prevent it slipping toward the point of the shears. Rubber sheeting strips and all kinds of soft packing can be easily cut with square or inclined ends. It matters not in what position the scissors are held, they will cut without slipping In using these scissors for rubber and other slippery goods, the saw toothed blade should be on the bottom to obtain the best results Heavy rubber and packing can be cut with less effort, as it is not necessary to hold the scissors against the goods to prevent slipping The same design of lower blade can be applied to plumbers and metal workers shears with a change in the relative positions of the holding and cutting blades If the saw toothed blade is kept on the bottom of the goods the edge will be left rough but by reversing the shears so that the saw teeth come on top the edge is left just as clean as if no teeth were used The piece cut off however is rough on the edge The scissors can be used to cut paper cloth or any other material, if the saw teeth are kept on top or bottom, according as it is desired to have the smooth edge on the left or the right hand piece cut off


SCISSORS WITH A SAW-TOOTH BLADE.

HOW TO WIND AN OPEN SPRING

BY OTTO KASNER

An easy way to wind a spring of the compression type will be found in the accompanying illustration The mandrel on which the spring is wound is selected according to size of spring wanted In this case the mandrel and the end of the wire were fastened in the chuck of a carpenter's brace The piece *A* is a narrow strip of metal the thickness of which regulates the spacing of the coils If a closed tension spring is wanted the piece *A* is left out entirely The wooden tension blocks are clamped with the proper tension in a vise *If no vise can be procured* an ordinary clamp will answer the purpose

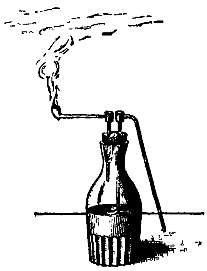


METHOD OF WINDING AN OPEN SPRING

THE SELF-SMOKING PIPE.

After filling a decanter about two-thirds full of water close it by means of a cork provided with two apertures Through one of these pass a short pipe stem and through the other a longer stem that enters the liquid

To the smaller tube affix a cork provided with two apertures The apertures may be easily formed by means of a red hot poker The lateral aperture serves to fix the pipe. Finally, with the other cork and a bent tube, form a siphon After the latter has been primed and is once in operation it will tend to empty the decanter, and the vacuum formed will be immediately filled by the external air flowing in through the pipe. It is then only necessary to light the latter in order to see it "smoke itself" tranquilly as long as any water remains in the decanter



THE SELF-SMOKING PIPE.

This experiment is a very interesting one and may easily be performed

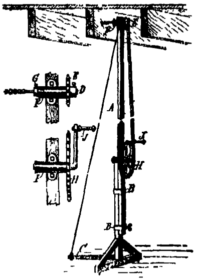
HOME-MADE KNOB AND TUBE BORING MACHINE.

BY R. H. BROCKMANN

To electricians who install knob and tube wiring a machine that will bore the overhead beams is a great time and labor saver The drawing shows a machine for this purpose that can be easily and cheaply made by anyone handy with tools.

The framework *A* is made of hard wood, oak or hickory, firmly put together and made long enough so that when fully extended it will reach ordinary high ceilings. The height can be adjusted by means of the sleeves *B* and the thumb-screw If it is too much bother to make the sleeves *B* ordinary iron clamps can be used *C* is a piece of wood fastened to the frame by means of a hinge at one end and a light flexible wire cable at the other *E* Points are formed at the bottom of the frame to keep the machine from slipping

A piece of machinery steel *D* is drilled to form a socket for the bit It is turned down to form a shoulder at the socket end and is then held in the ½-inch drop tee *F* while Babbitt metal is poured in to make the bearing A nine- or ten-tooth bicycle sprocket *E* is mounted on a bushing and fastened to the shaft with a set screw A set screw *G* is also provided to hold the bit in place Round shank bits are intended to be used The drop tee *F* is then fastened to the frame *A* by means of bolts. The sprocket *H* and crank and pedal *J* of a bicycle are mounted in a ¾-inch drop tee *I* and given a good bearing by pouring Babbitt metal around the axle. A hole is then bored through the other end of the axle and a washer and pin put on. The rat trap or cage part of the pedal is removed, this leaves the central part with the ball bearings, which makes a very good handle. The drop tee *I* is then bolted to the frame *A* and a bicycle chain *J* is fitted onto the sprockets *A* and *E*



HOME MADE KNOB AND TUBE BORING MACHINE.

To operate the machine, a bit of the proper size is inserted into the socket. The frame *A* is then extended to the proper height and made fast by means of the thumb screw The operator then places the machine in position with the bit against the beam, and with his foot bears down the pedal *C*, thus forcing the bit firmly against the beam, while he bores the hole by turning the handle *J*

◆

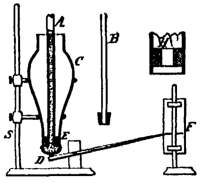
INEXPENSIVE APPARATUS FOR ILLUSTRATING THE "HYDROSTATIC PARADOX."

BY F. R. GORTON.

A simple method for illustrating the "hydrostatic paradox" with inexpensive materials is described below

In the small end of a large lamp chimney *C* is cemented with paster of Paris or paraffine the neck of a bottle of suitable size to fit a large rubber stopper (see *H* in figure) Across the small end of the chimney is tied a piece of thin sheet rubber *D* A small glass tube *B* and a larger one *A* are provided with rubber stoppers which fit well in the aperture *H* The apparatus is mounted firmly on the ring stand *S* as shown in the cut.

In the manipulation, tube *B* is inserted in the inverted chimney and filled with water to the level of the open end of *C* As the force exerted by the water against the rubber increases, the index rises The final position of the index is marked by a heavy black line on the cardboard which slides on the vertical rod *F* Now tube *B* is removed and the larger tube *A* inserted and filled to the same level The index rises promptly to the height marked by the line on the card *F* Finally tube *A* is removed and the chimney is filled to the brim. The index rises to the same point as before



APPARATUS FOR ILLUSTRATING THE "HYDROSTATIC PARADOX"

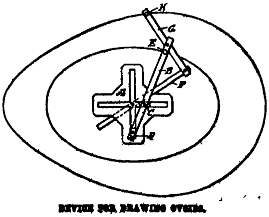
One of the chief merits of the device is the fact that no water has to be removed from the apparatus during the experiment —School Science and Mathematics.

◆

DEVICE FOR DRAWING OVOIDS.

BY J. O. BROUILLET

The instrument illustrated herewith can readily be made by any handy man and will enable him to draw ellipses of various sizes and ovoids as well It consists of a sheet metal piece *A*, in which two slots are cut crossing each other at right angles A lever *B* is provided with two blocks *C* and *D*, adapted respectively to slide in the slots. A lever *F*, which is fulcrumed at the center of the plate *A*, is connected by means of a lever *G* with the end of the lever *B* A pencil may be fitted through a hole in the lever *B*, and as this is revolved around the plate *A*, it will trace an oval or elliptical line. At the same time a pencil in the lever *G* will trace an ovoid, as indicated in the drawing.



DEVICE FOR DRAWING OVOIDS.

DEVICE FOR WASHING PRINTS.

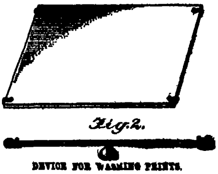
BY W. AND M. [illegible]

The device pictured herewith was devised to prevent prints from becoming torn while being washed. It is especially adapted to washing large prints, such as bromide enlargements, and is of such a simple construction that photographers will probably find it convenient to make several of them and thereby save much delay.

The material necessary is a quarter-inch board of slightly larger dimensions than the photograph to be washed, and four narrow steel springs; segments of a clock spring answer the case admirably. Each spring is clamped on the upper side of the frame, so that it turns over on the other side and securely holds each corner of the print. Besides the ease gained in moving the prints about, without injuring them, the photographs are always completely immersed if simply left to soak.

Fig. 1.

Fig. 2.



DEVICE FOR WASHING PRINTS.

◆

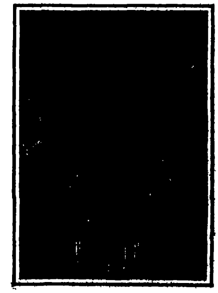
BLUE ROSES.

BY PROF GUSTAVE MICHAUD, COSTA RICA STATE COLLEGE.

The roses shown in the accompanying figure are white with a delicate and beautiful network of blue veins. Such roses can be obtained in little more than one hour by placing the following solution, instead of water, in the vase in which the cut ends of the stalks are dipping

Water	100 cubic centimeters.
Aniline methylene blue	2 grammes.
Potassium nitrate	2 grammes.

School boys know that white roses can be transformed into red flowers by allowing the cut end to remain some time in some kinds of red ink. The writer tried to obtain similar results with a number of aniline dyes and found that while some, like aniline red scarlet, for cotton readily rise into the vessels of the stalk, others, like aniline methyl green, will not under any circumstances reach the flowers. Some common salts were added to the dyes and one of them potassium nitrate (saltpeter) was found to exert a powerful influence over the ascent of the dyes, which rise then rapidly and in considerable quantities. The experiment is curious and should be repeated while using the blue liquid, the end of a few stalks being placed in some of the solution to which no saltpeter is added Aniline methylene blue is not one of the dyes which readily ascend in plants and it will be soon noticed that, while the flowers with the stalks dipping into the saltpeter and blue dye solution are covered with the blue network, nothing can still be detected on those whose stalks are allowed to dip in the same liquid but without saltpeter.



THE ROSES ARE COVERED WITH A NETWORK OF BLUE VEINS.

Will some botanist suggest an explanation of this influence of saltpeter on the ascent of dyes in stalks and flowers?

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

[illegible]-STRETCHER.—R. N. HALLETT, [illegible]. This stretcher can be folded for [illegible] for the convenience of travelers, the side bars having sections in which the stretcher members are pivoted, a central rod being provided, which has means for operating the stretcher members, which have means for limiting their movement away from the side bars.

Of Interest to Farmers.

PLOWING-MACHINE.—D. F. KUSTER and G. L. NIEMANN, Washtucna, Wash. This device may be used for disking and throwing the dirt either to the right or left, thus making it possible to go along the side hill, and when the end of the strip is reached the machine may be reversed and retraced along the same side, throwing the dirt down hill.

PLOW.—H. H. JULACH, Mount Hope, Wis. Among the principal objects of this invention is to provide a share which may be readily and quickly detached from the plow and as readily and quickly replaced, thereby permitting the operator to separate the part of the implement which requires sharpening, and to carry the same to the forge or blacksmith shop.

Of General Interest.

HOLDER FOR CONCRETE-REINFORCING.—J W REED, Hammond, Ind. The holder is constructed of a single piece of wire the same being bent to form an eye to embrace the reinforcing bar, with the end portions of the wire extended from the eye to provide nail prongs, the prongs being offset intermediate their length to provide striking faces, said nail prongs arranged to open the eye when spread apart, whereby the eye may be sprung over the bar

COMBINED HAMMER AND SIGHT.—A. M. POWELL, Valdez, Alaska. This inventor employs a front sight and a hammer provided with an extended portion having a hole through it and also having a notch disposed adjacent to said hole, the notch and hole being in vertical alinement relatively to each other and to the front sight when the barrel and hammer occupy their normal positions, so that either the hole or notch of the hammer sight may be alined with the front sight.

QUOIN.—M. MUCHLER, New York, N Y In view in this invention are means that prevent the separation of the wedges either by a relative endwise or lateral movement, and also means including a ratchet bar to automatically lock the wedges against endwise movement in a direction to decrease the thickness of the quoin, the rack bar being movable into and out of operation

HOLDER AND PROTECTOR FOR MUSICAL-INSTRUMENT STRINGS.—O. J MÜLLER, New York, N Y The aim in this case is to provide a holder for the strings, which will operate not only to retain the string in coiled form but will protect it against injury The string may be readily inspected without removing it from the holder, and is so secured in place that it may be very readily removed when desired

DISPLAY BOX AND TRAY.—E M. LEWIS, Moundsville, W Va. This combination box and tray is for use in packing goods, intended to be displayed by the retailer, in the original boxes as received from the manufacturer The invention is inexpensive enough to be applied to the cheapest box and at the same time so complete that it may be used with the most elaborate and costly creation of the box makers' skill

STARTING AND SEPARATING GATE.—R V JONES, Seattle Wash It is the object in this instance to obviate race starting accidents by providing means for locking each horse in a separate inclosure and starting the horses a sufficient distance apart, in order that they may not trample upon each other, nor allow the jockeys to interfere with one another when the horses start.

METHOD FOR FORMING SHEET METAL BODIES.—L N JONES, Defiance, Ohio. The intention of the inventor is to provide a method for forming the bodies in a very simple and economical manner and without danger of rupturing the sheet metal, and permitting the formation of the regular shaped bodies without the use of expensive machinery

LABIAL PROTECTING MEANS FOR DRINKING GLASSES, BOWLS, CUPS, SPOONS, AND THE LIKE.—L. JANCSY, 35 Rue des Martyrs, Paris, France. The invention relates to means adapted to prevent the lips from coming in contact with the edge of drinking receptacles. This labial means is substantially constituted by a part of varying shape sliding upon the edge of the glass and holding itself on the same, either in virtue of the nature of the substance comprising it or in virtue of its shape or its arrangement

SAFETY-ENVELOP.—E. HASEL, New York, N. Y. The envelop is of such a character that the various portions possess gummed surfaces, the arrangement of the various gummed surfaces being such that when the envelop is once sealed, the contents cannot be reached except by mutilating several layers of paper, disposed one upon the other and thoroughly bonded together.

[illegible].—R. A. HARRIS and B. G. [illegible], Mount Pleasant, Mich. The invention relates particularly to the provision of hinged side doors for relieving pressure within the chute and allowing the lateral discharge of the beans as the bin is filled, the doors and spring attachment thereof being so applied as to offer no material obstruction to the withdrawal of the chute from the bin, when it has been filled.

DENTAL TOOTH CLAMP.—G A. HARPER, Shreveport, La. In this dental appliance the improvement is in the nature of a clamp for application to a tooth and having means for holding cotton rolls or napkins, such as used by dentists in keeping moisture away from a tooth while filling the latter, and also means for supporting a mirror

Hardware.

SCALE.—S. C COOPER, Nunda, N Y In this patent the invention refers to measuring instruments, and the intention is to provide a new and improved weighing scale arranged to permit the minute adjustment of the poise to insure accurate weighing and to allow convenient reading of the result.

SEAL ATTACHMENT FOR LOCKS.—C H JOHNSON, Petaluma, Cal The invention is intended for use especially on locks used on suit cases, trunks, boxes for legal papers, jewel boxes, and the like By the use of this device a seal may be placed over the lock and the same covered up and protected, so that the lock itself cannot be unlocked without breaking the seal.

Heating and Lighting.

STEAM-GENERATOR.—F N TILTON, Hartford, Conn. The object in this case is to provide a new and improved generator having no sharp bends and but few and straight joints between the pipe coils, the latter being arranged to permit ready assembling and to allow convenient access to any one of the coils.

Household Utilities.

SASH HOLDER AND LOCK.—T KEPHART Sinnamahoning Pa. For the purposes of this invention use is made of upper and lower runners fixed on a window frame and spring lever devices held on the sashes and adapted to engage the runners to hold the sashes open by frictional contact, the said lever devices and runners having interlocking means for locking the sashes in a closed position.

Machines and Mechanical Devices.

HOISTING APPARATUS.—H W BACHALDER, Schenectady N Y Means are in view in this improvement for swinging the boom, comprising two drums driven one from another to rotate in opposite directions, actuating means for the drums, and means for simultaneously connecting the actuating means with one of said drums and disconnecting the actuating means from the other drum

DRUM BATCH MIXER.—W R TUTTLE, Nunda, N Y The object of this invention is to provide a mixer which may be charged and discharged more quickly and thoroughly than those now in use one which will thoroughly mix and knead concrete and other materials, and one which has its members so constructed and disposed that the greatest strength and efficiency will be obtained.

AUTOMATIC PRESSURE CONTROL.—J H SMITH Rochester, N Y In this invention use is made of a cut-off valve located at the hydrant and having its outlet connected with the hose, so that on closing the nozzle gradually or abruptly a corresponding automatic closing of the cut-off valve takes place and on opening the nozzle a corresponding opening of the valve is had

SHAFT COUPLING.—F B RICHARDSON, Slidell, La This device while joining two shafts together with the utmost security, may be easily stripped from one of the shafts and permit of the latter's withdrawal through a bearing or other constricted place This is accomplished by constructing the coupling with a split collar and binding the two halves or portions thereof firmly together, when the coupling is assembled by an intermediate ring.

CLAY-GATHERING MACHINE.—C. E. OLDEN, Mason City Iowa. By use of this device dry clay may be collected without the necessity of digging the same and throwing the clay into wagons by hand. The clay may be scooped up into a proper receptacle and the latter can be emptied by means of levers and an appropriate clutch mechanism, thereby facilitating the unloading process.

PHONOGRAPH.—F E HOLMAN Silverton, Ore A record surface is provided in this case of a flexible nature, and having a relatively great length may be inserted or removed and in which the bearing members for the cylinder are pivoted to admit the removal or replacement of the record The record is applicable to the cylinder type in which the virtual diameter of the record is greatly increased, while the actual is not

Prime Movers and Their Accessories.

ROTARY ENGINE.—G SCHULZ, New York, N. Y. The more particular purpose of the inventor is to provide a type of rotary engine in which an explosive charge is first compressed by the immediate and direct action of the engine, and it is then exploded so that advantage is taken of its expansibility

Railways and Their Accessories.

RAILROAD-TRACK-RAIL HOLDER AND BRACE.—J. T WEST, Bowling Green, Ky The holder provides means for securing a rail upon a cross tie, by the lateral insertion of a spike through a depending member of each rail holder into the side of a cross tie whereon the rail is seated It is adapted for bracing the head of a track rail against laterally-applied strains.

CAR-COUPLING.—W S. LENNON, Tucson, Ariz. The invention relates to automatically operated car couplers. This automatic coupler may be operated without requiring the brakeman to pass between the cars. The coupler is ice and sleet proof, and it may be easily coupled without excessive jamming when the cars are on a curve.

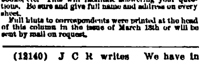
Pertaining to Vehicles.

VEHICLE-WHEEL.—T HÜBSCHER, Weehawken Heights, N J This wheel is designed to offer little resistance to the air The rim with the tire may be readily detached and replaced and the wheel presents few parts on which dust and dirt may collect, and the tire bolts, air valve, and other parts of the inside of the wheel are protected from the weather

COMBINED STEERING AND DRIVING AXLE.—J W BUCHAN, Eastman Ga. In this patent the aim is to furnish a device which combines the features of a steering and driving axle and which is further provided with means whereby the wheel can be adjusted on the supporting sleeves of the steering knuckles as the bearings become warm

DUMPING WAGON T WRIGHT, Jersey City N J The invention pertains to dumping wagons and carts such as used by coal dealers in delivering coal The object is to produce a wagon having improved mechanism for raising the body into an elevated and inclined position for dumping the load The means are capable of raising the body to an unusually high elevation.

NOTE.—Copies of any of these patents will be furnished by Munn & Co for ten cents each Please state the name of the patentee title of the invention and date of this paper



Notes and Queries.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of March 13th or will be sent by mail on request.

(12140) J C R writes We have in trigonometry minus as well as plus angles (A minus angle being one generated by a line moving about a point in a clockwise direction) Also, in regard to functions of plus angles (those angles generated by a line turning about a point in an anticlockwise direction) we have the following I quadrant sin and cos. both plus. II quadrant sin plus, cos. minus. III quadrant sin and cos. both minus IV quadrant sin minus, cos. plus. What I wish to know is, what are the signs of the respective functions of minus angles in the four quadrants, and the reason why? A There are several uses for the signs plus and minus. First to show the nature of a quantity as positive or negative second, as signs of the operations of addition and subtraction, third, to denote the direction of motion, as in the case of the angles produced by the rotation of a radius, which you specify, fourth to indicate the direction in which a quantity is changing or moving as in denoting north latitude by plus and south latitude by minus or the degree of the thermometer above zero by plus and below zero by minus. The functions of an angle in trigonometry are similarly denoted A line drawn upward from a horizontal diameter or to the right of a vertical diameter is plus, while one drawn downward from a horizontal and to the left from a vertical diameter is minus. With this rule or usage in mind there is no difficulty in giving the signs of all the functions in all the quadrants.

(12141) C D says I inclose a clipping concerning the Star of Bethlehem. Similar items have been going the rounds of the papers. What foundation is there for their statements? I can find no such star nor can I find anything in the reference books concerning the Star of Bethlehem I had supposed that the so-called Star of Bethlehem was one of our own planets probably Venus, and must some time have seen a statement to that effect but I can find no authority for it now A. There is no star known to astronomers as the Star of Bethlehem' Nor is there any star known which returns every 500 years The statements you send us in the clipping are the fanciful emanations of some fantastic brain It is barely possible that on a hazy night the planet Mars, which has been recently very brilliant in the evening sky, may have been seen to change in brightness and color as the haze passes over it, partly obscuring it. Such performances as the clipping describes cannot possibly have been seen in any heavenly body. There is no scientific knowledge regarding the "Star of Bethlehem," as described in the Bible. The Bible says all that anyone can say about it.

(12142) J W says I am going to construct a wireless, and wish to know the necessary apparatus for a 100-mile wireless sending and receiving apparatus. Would be very grateful for any information regarding same. A You will find a full description, with drawings and all specifications, for a wireless telegraph outfit to transmit 100 miles, in our SUPPLEMENT No 1 605, price ten cents.

(12143) J L. B says What chemicals can be compounded that will expand in cold weather and contract in hot weather? What minerals will expand in cold weather and contract in hot weather? A. You will find in Carhart's University Physics," Vol 2 page 24 the statement that Rose's metal contracts after the temperature reaches a certain point. This is an alloy composed of bismuth 2 parts, lead 1 part and tin 1 part. He also states that iodide of silver contracts regularly from 10 deg C to 70 deg C and that it reaches its point of maximum density at 116 deg C These statements we give you as they are given in the book referred to which we can send you for $1 75 postpaid Besides these we know no others

(12144) J L. B says I desire to construct storage cells in Crowfoot jars, using commercial sheet lead 2½ to 3 pounds per square foot About how many ampere minutes could I expect from each square foot of the oxidized plate if the cell is otherwise properly constructed? Would it be advisable to make the plates rough by deep scratching? What is the best concentration of acid to use? A. You will find in several of our SUPPLEMENTS plans and full descriptions of storage batteries of different forms We beg to refer you to Nos 845 1195 and 1433 which we will send for ten cents each You should not use smooth sheet lead The time of forming and the cost will be greatly increased We cannot tell what ampere minutes you will get per square foot The composition of the electrolyte is given in the descriptions in the SUPPLEMENTS referred to above

(12145) A. R. J says Kindly describe in your columns the process of making 72 deg and 76 deg gasoline Does it have to be charged with a natural or manufactured gas, or does the product itself contain the gas that makes it suitable for explosive motors? A Gasoline is produced by the simple distillation of crude petroleum of which it constitutes about 1.5 per cent It is the third product to come off at about 140 deg to 158 deg F the only lighter distillates volatilizing at a lower temperature being rhigolene which comes off at 113 deg and chymogene, from 113 deg. to 140 deg of both of which the percentage is extremely small The next heavier product is benzine or naphtha (which comes off all the way from 158 deg to 248 deg) Commercial gasoline however contains a good deal of the latter and runs up in gravity to 0 66 or 0 67 true gasoline being from 0 636 to 0 65 Gasoline is not charged with any other gas the explosive gas used in gasoline engines is a mixture of gasoline and air gasoline being very volatile i. e. evaporating rapidly its vapor being absorbed by air as water is by a sponge and the mixture being explosive The mixture of gasoline vapor with air is known as carburetion

(12146) J B says A train starts from rest and reaches its highest speed say 60 miles per hour in 5 minutes At the end of this time steam is immediately shut off and the train allowed to coast until it comes to rest How long will it take to come to rest coasting on a level track and friction alone retarding it? I maintain that the problem as it stands cannot be answered Am I correct? A Your problem is not solvable Neither the weight of the train nor the coefficient of friction are given Moreover the data you give are not concerned in the solution of the problem you state It matters not how long or by what force the train reaches its velocity When steam is shut off a train has a velocity of 60 miles per hour In what time will the train come to rest on a level track That is all you state toward the problem It is insufficient An engineer may assume data but these are not given in the problem as stated

(12147) N P W says Two cylindrical columns of wood iron or concrete have the same length and the same diameter and are identical in every respect save that one is hollow while the other is solid A claims that the hollow column will be stronger (with reference to any force tending to break or buckle it) and B claims that the solid one will be stronger Will you please oblige a subscriber by explaining in your query column plainly enough for the proverbial wayfaring man to understand it, which is right and *why?* A B is right The solid column will be the stronger, whether composed of wood iron or concrete or whatsoever material or whether resisting compression tension torsion or any other strain As contention arises from a not uncommon misunderstanding of the well known rule that a tube is stronger than a solid rod *of the same weight* i. e. that a rod of one inch diameter will stand less endwise compression or torsion than *the same weight or volume* of metal would stand if made into a hollow column or tube of the same length and, say, two inches outside diameter

NEW BOOKS, ETC.

A Hand Book of General Instructions for Mechanics. Containing Useful Rules and Memorandum for Practical Men New York D Van Nostrand Company 1909 12mo., 328 pp. Price, $1 50

The primary object of the author in writing this book is to give the mechanic, who has not had educational advantages, a text book explaining established rules for calculating in a clear simple and concise way, making him familiar with the various technical terms and their meaning and to be in general such a course of instruction as to impart in a simple manner the required knowledge to enable him to read understandingly more advanced works. The plan of the book is excellent, and the illustrations and examples are particularly clear There is hardly anyone who has much occasion to use figures who would not be benefited by a perusal of parts of this book.

Precious Metals Comprising Gold, Silver and Platinum By T Kirke Rose A.R S M, D Sc New York D Van Nostrand Company 1909 12mo 295 pp Price $2

This is one of the volumes of the Westminster Series," which has proved such an excellent collection of technical literature The present volume deals with the methods of treating gold by the wet and dry process. The extraction of silver the refining and assaying of gold and silver ores, the assay of gold and silver bullion minting the manufacture of gold and silver wires, and a valuable chapter on platinum together with tables on the production of precious metals There has been room for a good book on gold and silver for some little time This book seems to fill the niche admirably

Motorman's Practical Air Brake Instructor By George R. Denehie Chicago Frederick J Drake & Co, 1909 18mo, 280 pp, leather back

This is a concise up to date treatise on the construction and operation of the different air brake equipments used in modern electric transportation The author has been at considerable pains, therefore to collect condense and compile all the latest available information bearing upon this most important subject of handling an electric car or a train of cars safely and at the same time economically The diagrams and illustrations are particularly clear Some of them are reproduced in colors The get up of the book however is not equal to another book on the same subject which we reviewed a short time since

Life of Sir Charles Tilston Bright, Civil Engineer By Charles Bright F R.S E. London Archibald Constable & Co Ltd New York D Van Nostrand Company, 1908 8vo 478 pp Price $4 50

In this book is incorporated the story of the Atlantic cable and the first telegraph to India and the colonies. In response to a number of suggestions in view of the fiftieth anniversary of the Atlantic cable Mr Bright has brought out an abridged edition of the biography of his father the original work having been written by Sir Charles Bright's brother and by his son There is probably no branch of engineering which lends itself so readily to a full sight of the world as that of telegraphy Therefore the present volume will appeal to the general reader only in a lesser degree than to the engineer the student and the historian Sir Charles Bright was as much a traveler as a scientist and even when engaged on the most trying cable venture in unhealthy climates, he invariably kept a neatly written record of the day's performance of what he had seen and learnt never retiring to bed without attending to his task The detail to be drawn upon is very large and the author has certainly made an excellent selection The story of the Atlantic cable is one of the most romantic in the history of science and it is gratifying that the biography of the pioneer should be written by his son

The Lead and Zinc Pigments By Clifford Dyer Holley M S Ph D New York John Wiley & Sons, 1909 12mo. 340 pp 85 figures Price $3 net

New pigments have come into use during the last ten years new processes have been developed for the manufacture of the older pigments new combinations of pigments have been worked out that have secured results hitherto unattainable Yet up to the time mentioned above except for short articles in some of the trade papers these improvements and innovations remained practically unnoticed. Since public attention has been directed to the paint industry by the enactment of the various State laws regarding the sale of paint materials several excellent American works have been written on this subject but the majority of them has been directed more particularly toward the compiling of analytical methods and data than to the manufacture and uses of the various pigments In this work the author has attempted to record the progress made in the United States in the manufacture of the more important pigments and hence but little space has been given to European methods and processes except for comparison, as they have been discussed in detail in various English and European works.

Manual of Steam Engineering. By W. H. Wakeman. New York and Chicago New York Belting and Packing Company.

Mr Wakeman's name is familiar to readers of the Scientific American Supplement, as well as to readers of technical journals in general as the author of many articles on engineering subjects. In this little book he has presented instructions, suggestions, and illustrations for steam engineers concerning the application to modern daily practice of the approved theory of steam engineering. Although the work is issued no doubt as an advertising pamphlet, it is essentially an engineering reference book containing data that are required in everyday practice, arranged in convenient form and with sufficient explanation to render the matter both interesting and instructive

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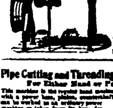

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CHEMISTRY OF SOLDERING AGENTS.

(Concluded from page 389.)

chloride preparations are very convenient in use and very reliable, causing the solder to adhere firmly Even when the surfaces to be joined are greatly oxidized, a good joint can be made by a skillful workman. In order to prevent the possibility of injurious after effects, it is customary to wash the soldered joint with zinc chloride solution. Cable joints made with the aid of zinc chloride were opened and examined after the same intervals of time that were allowed for the joints made with ammonium chloride Although the zinc chloride also penetrated between the wires the difference in the result was very great. The wires of the core were covered with a dry, wax like dark green coating, and a substance resembling pitch was found in places where the other ingredients of the zinc chloride soap had been decomposed by overheating, but junctions which had been traversed by strong currents for long periods showed no appreciable increase in resistance

The assertion that injurious effects are necessarily produced by hydrochloric acid separated by hydrolysis from the hygroscopic zinc chloride was also submitted to the test of experiment. Copper wires less than 1/250 inch in diameter were soldered together and the junctions were covered thickly with the zinc chloride mixture and inserted in an apparatus with which their resistance could be measured while a current was kept flowing through them In a few days the mixture became moist, but it quickly dried and assumed the wax like appearance described above The wires were exposed freely to the air, but observations continued through a long period revealed no deterioration of the joint

Hence it may be asserted, as the result of exhaustive researches continued for years, that zinc chloride is in every way superior to ammonium chloride as a soldering agent. The inference that ammonium chloride is safe because it is possible to obtain it unmixed with free acid, is a pure delusion, for the injurious action of ammonium chloride on metals is due, not to the comparatively harmless hydrochloric acid, but to the other causes mentioned above

The extraordinarily good practical effect of zinc chloride preparations, however, still requires explanation —Zeit. f. Ang Chemie.

SOUNDING THE OCEAN OF AIR.

(Continued from page 393)

mer, autumn, or winter Kites and balloons have been sent up from almost every quarter of the earth Perhaps the most recent of these investigations in an out-of-the-way quarter of the globe is the meteorological expedition to East Africa undertaken by the Royal Prussian Meteorological Observatory The expedition was conducted by Prof Berson and Prof. Elias. The chief object was to determine the origin of monsoons, an object which was not altogether attained, but on which much light was thrown An ultimate aim was the prognosis of the rainy season in East Africa and India. On the coast and from a specially chartered steamer on the lake, *ballons-sondes*, pilot balloons, and kites were sent up. The observations over the equator, in the center of the continent, showed very low temperatures at great heights, as did the expedition of Teisserenc de Bort and Rotch on the equatorial Atlantic, but with the difference that over the African continent there was a trace of the permanent inversion layer The vertical changes were as follows adiabatic decrease of temperature to 12,000 meters, between 13,000 and 15,000 meters a small inversion, and above 17,000 meters isothermal conditions Above the southeast monsoon the wind was south-southwest, and three times a westerly wind was observed between 15,000 and 18,000 meters, above the great equatorial current from the east which is supposed to prevail at all heights.

It was feared that a very large per cent

(Continued on page 400.)

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of the balloons which fell on land would be lost, because of the nature of the country and the sparseness of the population, but on the contrary an astonishing proportion of them was recovered, owing to the keenness of vision of the natives, to whom a small reward was offered for every one returned

What has been the result of this international aerial sounding? It has been discovered that all over the earth the air is stratified in three more or less distinct layers The lowermost of these, the layer in which we live and which extends upward for two miles from the surface of the earth (at which height the freezing point is encountered) is a region of turmoil warm to-day and cold to-morrow This is the stratum of capricious winds, cyclones and anti-cyclones, of cool descending currents and warm ascending currents All our weather forecasting is at present based on what can be learned from the general circulation of the air in this lowermost layer

Above this first layer, which extends upward for perhaps two miles, begins the second layer, which is about six miles thick, and is less turbulent than the first. In it the air grows steadily colder and drier with increasing height. Temperatures as low as 167 deg below the Fahrenheit freezing point have been recorded here Whatever thermal irregularities there may be are caused by temperature changes on the surface of the earth and by the reflection of solar heat from clouds The wind blows always in the same easterly direction, and the greater the height, the more ferocious is the blast.

The last of all the layers thus discovered lies above this Originally revealed by Teisserenc de Bort and Dr Richard Assmann almost simultaneously it was first known as the 'isothermal stratum' because its temperature seemed to be stationary Later when it was found that the temperature, instead of remaining fixed gradually increased, it was rechristened the "permanent inversion layer" The height of the inversion layer has not as yet been determined It must not be supposed that, because its temperature rises it is much warmer than in the second layer As a matter of fact, its temperature must be placed somewhere between 122 deg and 140 deg below the Fahrenheit freezing point. This permanent inversion layer is puzzling in the extreme In passing from the second to the permanent inversion layer the wind is stilled to a breeze the velocity decreasing from 25 to 80 per cent. The air blows no longer in a steadily easterly direction, but almost as capriciously as it does at the surface of the earth Dryness, excessive dryness is another characteristic of the permanent inversion layer In summer time the permanent inversion layer begins at a height of about 7½ miles above the earth, the higher it lies, the colder it is the lower it lies, the warmer it is There is no bodily shifting up and down of warm and cold masses of air so that a current ascending from the lower level spreads out when it encounters the permanent inversion layer, just as hot air which strikes the ceiling of a room

Up to about 10 kilometers the decrease of temperature is almost adiabatic, then in the next 5 kilometers there is usually a rise in temperature of 8 deg to 10 deg C with isothermal conditions up to at least 26 kilometers The lower zone Teisserenc de Bort calls the "troposphere" and the upper one the 'stratosphere' The former is a region of violent atmospheric disturbances for it has been shown that cyclones do not extend above the cirrus clouds though anti-cyclones persist to greater heights and therefore the stratosphere is lowest in the cyclone and highest in the anticyclone and its level sinks from the equator to the poles The stratosphere is a region of interlaced currents and small vertical movements

Up to the height of the permanent inversion layer, the temperature falls at an average of one degree C. per 100

(Concluded on page 401)

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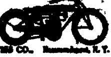

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Gases, apparatus for purifying burner, J. B. F. Herreshoff	[illegible]
Gases, purification of burner, J. B. F. Herreshoff	[illegible]
Gasoline engine, J. C. Johnson	[illegible]
Gate, J. M. Mullen	[illegible]
Gate hook, C. L. Smith	[illegible]
Gate operating attachment, J. R. Faulkner	[illegible]
Gear train, double pinion toothed, W. Trewhella	[illegible]
Gearing, H. C. Schroeder	[illegible]
Gearing, friction, J. L. Graham	[illegible]
Glassware, mechanism for producing hollow, C. J. Koenig	[illegible]
Grader, road, Hadley & Smith	[illegible]
Grain drier, P. Provost	[illegible]
Grass crimping apparatus, W. F. Wyman	[illegible]
Grate, revolving, A. L. Wilson	[illegible]
Grinding machine, C. H. Norton et al	[illegible]
Grinding machine driving gear, J. M. Thompson	[illegible]
Grinding mill, J. C. Clark	[illegible]
Gun hose, automatic, G. L. Weisel	940,161
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Hammers, die holder for drop, W. F. Gorton	[illegible]
Hammers, water attachment for pneumatic, Carnahan & Murphy	[illegible]
Harness, H. H. Crawford	[illegible]
Harrow, E. C. Bowman	[illegible]
Harrow, disk, C. S. Sharp	[illegible]
Harrow, guarded end steel level, W. E. Johnson	[illegible]
Harvester, beet, G. A. Pingree	[illegible]
Hat, J. R. Rash	[illegible]
Headlight cover, C. W. Houghton	[illegible]
Headlight, locomotive, S. W. Emery	[illegible]
Heat transmitter, H. Friedenthal	[illegible]
Heating apparatus, N. B. Wales	[illegible]
Hinging gage, W. H. Gelbaugh	[illegible]
Hod, H. McLane	[illegible]
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Holdback, M. D. Schaller	[illegible]
Holder, G. Stocker	[illegible]
Horseshoe, O. Loeffler	[illegible]
Horseshoe calk former, E. N. Childs	[illegible]
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Ingot mold, E. Gathmann	[illegible]
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Insole or support for deformed feet, L. Tauber	[illegible]
Insulating fabrics, making, C. F. Peterson	[illegible]
Kinetoscope, Pink & Fletcher	[illegible]
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Knockdown box, T. A. Brenner	[illegible]
Labeling machine, F. O. Woodland	[illegible]
Lacing tool and square, belt, H. T. Mumford	[illegible]
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Lens grinding machine, F. Buchhop	[illegible]
Lifting jack, H. Cook	[illegible]
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Lightning arrester, C. T. Mason	[illegible]
Lightning arrester, E. W. Vogel	[illegible]
Lip turning machine, W. H. Hooper	[illegible]
Lip turning machine, channel, W. H. Hooper	[illegible]
Liquid fuel burner, E. M. Hammond	[illegible]
Liquid fuel combustion engine, H. B. Metz	[illegible]
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Lock, B. Borland	[illegible]
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Logging car standard attachment, M. Majette	[illegible]
Loom for weaving tufted pile fabrics, J. P. Humphries	[illegible]
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Loom warp, means for applying wax to, W. F. Mintel	[illegible]
Loom weft replenishing mechanism, automatic, M. L. Stone	[illegible]
Looms, differential filling supply gaging device for, S. S. Jackson	[illegible]
Lubricator, J. A. Martin	[illegible]
Lubricator, R. C. Agner	[illegible]
Magnetic separator, W. B. Moore	[illegible]
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Mailing tube, V. Guertin	[illegible]
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Match safe, W. G. Monk	[illegible]
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Measuring instrument, O. W. Dolph	[illegible]
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Measuring tank, Herald, Smith & Meyer	[illegible]
Metal working machine, Hanford & Marshall	[illegible]
Metal working machines, work support for, W. F. [illegible]	[illegible]
Metallic tie, M. F. [illegible]	[illegible]
Meters, gearing for, A. F. [illegible]	[illegible]
Milk heater, J. H. [illegible]	[illegible]
Mine, submarine, A. F. [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

[illegible] F. per 183 feet). Because of the constant upheavals to which the air is subject in its lower levels, this average rate of temperature reduction as we ascend is not always observed. Sometimes it even happens that for a short distance the thermometer rises instead of falls, but ultimately the temperature drops at a uniform rate until it reaches a point lower than that recorded by any North Pole explorer

The three layers of air which have been discovered by kites and balloons intermingle but slightly; one floats upon the other as oil floats upon water Of the great ocean of air at the bottom of which we move and live, three-fourths lies below the permanent inversion layer All our storms, our clouds or dust are phenomena of the lower two layers.

◆

Treatment of the Eye by X-Rays.

(Continued from page 394.)

cyclitous stages, a very moderate application of X-rays does not have an injurious effect upon the ocular tissues and is able, with the aid of local medication, to overcome the disease. In this connection I may cite a personal experience, in which one of my patients was afflicted with a serious ocular traumatism, perforation of the cornea, traumatic cataract, and plastic iridocyclite of fifteen days' standing. The case was brought to me for consultation on the 2d of February, 1907

The eye was hypotonous, vision was extinct, hardly a sensation of light being preserved The case seemed to be hopeless, and in despair I made, in the course of one week, four applications of X rays, extending from the 2nd to the 14th of February, and simply prescribed atropine.

On the 3d of April improvement was apparent, the eye resumed the normal tension, although there still remained perikeratic inflammation and only a very weak luminous perception.

A new radio-therapeutic treatment was effected the same day, and on the 5th of June all traces of the inflammation having completely disappeared a month previously, I was able to extract the cataract with complete success.

It is certain that one single case is not as safe to base conclusions on as is a series of observations on analogous cases I have always thought, however, as a result of my experience in this case that I would never have been able to obtain such a rapid improvement and radical cure without X-rays.

Since 1907 I have treated in this manner six cases of iridocyclite and a case of optic neurosis by the continuous rays In the four initial treatments I have never applied irradiation too strongly, since the very first case (cataract and leucoma) revealed to me the danger of repeated treatments. The treatment has been considerably diminished in duration, and the cure is effected more rapidly than by ordinary medication Irradiation of neurosis six times in the course of two months did not result in any improvement, but was terminated by optical atrophy

This personal experience corroborates the conclusions of Cook and of Coover regarding the discontinuous effects of X-rays. The observations reported by the latter apply to *intermittent* X rays, which seem, in those cases where they have been utilized, to have a particular efficacy upon processes of cellular regeneration.

The cases treated by Coover related to four ulcerous corneas, two iridocyclites, and three optical atrophies. The ulcers and the iridocyclites were cured in a few treatments, and as for the atrophies of the optic nerve, an improvement was achieved in one case after four treatments, in another after three treatments, and in the last case after seven treatments.

These really striking results, especially in cases as grave as optic atrophy, lead [illegible]

(Concluded on page [illegible])

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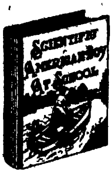

THIS book is a sequel to "The Scientific American Boy," many thousand copies of which have been sold, and has proven very popular with the boys. The main object of the book is to instruct boys to build various devices and apparatus, particularly for outdoor use. The construction of the apparatus, which is fully within the scope of the average boy, is fully described and the instructions are interwoven in an interesting story, a feature which has assisted in making the "Scientific American Boy" so popular with the boys.

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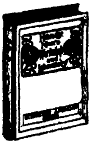

EVERY practical mechanic, whether amateur or professional, has been confronted many times with unexpected situations calling for the exercise of considerable ingenuity. The resourceful man who has met an issue of this sort successfully seldom, if ever, is averse to making public his methods of procedure. After all he has little to gain by keeping the matter to himself and, appreciating the advice of other practical men in the same line of work, he is only too glad to contribute his own suggestions to the general fund of information.

About a year ago it was decided to open a department in the Scientific American devoted to the interests of the handy man. There was an almost immediate response. Hundreds of valuable suggestions poured in from every part of this country and from abroad as well. Not only amateur mechanics, but professional men as well were eager to recount their experiences in emergencies and offer useful bits of information, ingenious ideas, wrinkles or "kinks," as they are called. Aside from these many valuable contributions came from men in other walks of life—resourceful men who showed their aptness at doing things about the house, in the garden, on the farm. The electrician and the man in the physics and chemical laboratory furnished another tributary to the flood of ideas. Automobiles, motor cycles, motor boats and the like frequently call for a display of ingenuity among a class of men who otherwise would never touch a tool. These also contributed a large share of suggestions that poured in upon us. It was apparent from the outset that the Handy Man's Workshop Department in the Scientific American would be utterly inadequate for so large a volume of material, but rather than reject any really useful ideas for lack of space, we have collected the worthier suggestions, which we present in the present volume. They have all been classified and arranged in eight chapters, under the following headings:

I, Fitting up a Workshop; II, Shop Kinks; III, Soldering of Metals; IV, The Handy Man in the Factory; V, The Handy Man's Experimental Laboratory; VI, The Handy Man's Electrical Laboratory; VII, The Handy Man About the House; VIII, The Handy Sportsman; IX, Model Toy Flying Machines. Index.

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THIS work should appeal strongly to all those interested in ornamental concrete, as the author has taken up and explained in detail in a most practical manner the various methods of casting concrete in ornamental shapes. The titles of the thirteen chapters which this book contains will give a general idea of the broad character of the work. They are entitled:

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The first two chapters explain a most unique and novel method of working pottery which has been [illegible] the author. The chapter on color work alone is worth [illegible] the cost of the book inasmuch as there is little known on this subject, and there is a large and growing demand for this class of work. The author has taken for granted that the reader knows nothing whatever about the material, and has explained each progressive step in the various operations throughout the work. These [illegible] have been supplemented with half-tone and line illustrations which are so clear that any one can understand them. The amateur craftsman who has [illegible] will especially appreciate the adaptability of concrete for pottery work, [illegible] a cold process throughout, [illegible] away with the necessity of [illegible] necessary with the [illegible]. The book is well [illegible] on heavy glazed paper and [illegible] illustrations [illegible] show the unlimited possibilities of [illegible] in concrete.

MUNN & CO., Inc., Publishers, 361 Broadway, [illegible] us to hope that in a not far distant time we shall be able to cure this redoubtable affection, or may at least be able to prevent its evolution from the moment that the diagnosis has been made.

Time alone will assure that the cures related by Coover are permanent. The results so far achieved, however, deserve, in my estimation, our serious consideration.—Cosmos.

◆

Test of an American Helicopter.

In the recent Berliner-Williams helicopter trials at Washington, D. C., on the farm of Mr. Emile Berliner, the two revolving-cylinder motors of Mr. Berliner rested upon the platform of the machine, each being connected by its own countershaft to the main gear-wheels of the oppositely revolving propeller shafts, which are tubular and concentric. Mr. Williams also stood upon the platform, on the opposite side of the shaft from the motors. The total weight lifted in this trial, including Mr. Williams, was 610 pounds. The weight of the complete helicopter without him was 460 pounds, and the two motors, with countershafts, pinions, connections, etc., weighed 248 pounds.

In previous trials each of the motors, installed singly, had lifted the machine, with a little added weight upon an outrigger, for balance, the thrust, or lift, being about 350 pounds, which compares favorably with previous experiments made by Mr. Berliner last fall, when, with a single propeller of somewhat greater diameter and area, he got about the same results.

The two motors, which are duplicates, are of the star-shaped 5-cylinder, revolving type of 36 rated horse-power. They were built specially for Mr. Berliner and they had been overhauled, tested and worked into good running shape at Mr. Berliner's laboratory.

The helicopter, built by Mr. J. Newton Williams of Darby, Conn., about two years ago, was first tried with a motor that proved to be too small for the work. It was then connected by flexible shafting to the factory power to test the thrust of the propellers, which in a series of trials with from 13 to 19 measured B. H. P. lifted from 250 to 430 pounds, and in a final trial in which the horse-power was not measured, a thrust was obtained of 560 pounds. The machine was later taken to Hammondsport, N. Y., where an 8-cylinder 40 horse-power Curtiss motor was installed, and a number of trials made, the motor lifting the machine with added weight totaling from 410 to 485 pounds, but not being equal to lifting the weight of an average-sized man.

In this last trial at Washington the blades of the propellers had been enlarged, increasing their diameter from 16 feet 8 inches to 18 feet 8 inches and increasing their area from 64 to 80 square feet. This increase of superficial area of the propellers increased the general efficiency of the machine, as the greater lifting surface gave a greater resultant lift per unit of horse-power, and the reduced revolution speed of the propellers, due to increased resistance, gave a reduced revolution speed to the motors, which, with the transmission used, seemed to give them greater efficiency.

The propeller speed was 120 R. P. M., while the speed of the motor was 900 R. P. M.

Mr. Williams expects to have a 7 cylinder motor built of the same revolving type, and of 50 per cent more power, and will also build a helicopter on about the same lines, but of larger size and lighter construction.

The completed machine will have a parachute to retard the fall in an emergency, and its dirigibility is assured by very simple controlling devices, which are now being patented.

◆

It is regrettable that the Lighthouse Board has changed the name of the buoy marking the historic spot where the ironclad "Merrimac" went down after her defeat by the "Monitor." "Merrimac wreck buoy 28" will now be called "Channel buoy 28."

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On December 11th, 1909, the Scientific American will issue a number devoted entirely to the wonderful Middle West region of the United States, a number which will set forth broadly and lucidly not only the agricultural interests of that region, but also those larger engineering undertakings which are destined to transform the Middle West, in part at least, into a manufacturing territory.

With that object in view the Middle West Number will publish articles on the following subjects:

I. The Chicago and Gulf Waterway.—An illustrated description of Chicago's drainage canal, an engineering work which stands without a parallel in the world.

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III. The Wonderful Grain Trade of Chicago.—Chicago is an enormous wheat bin, into which much of the grain raised in the middle West is poured.

IV. Shipping on the Great Lakes.—Most of the iron ore that is now smelted in Pennsylvania is mined in the middle West. To transport it to the blast furnaces of the East at a cost which will enable American steel makers to compete with foreign steel makers, it has been necessary to devise a new kind of lake transportation. Ships of 10,000 and 12,000 tons burden have been constructed which convey ore at small cost through the Great Lakes, and which are without a counterpart anywhere in the world.

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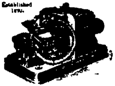

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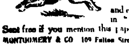

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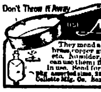

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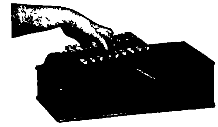

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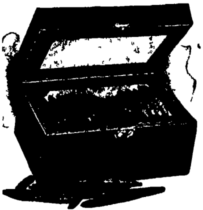

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A ZEPPELIN RAILWAY.—[See page 411.]

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NEW YORK, SATURDAY, DECEMBER 4th, 1909

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention Accepted articles will be paid for at regular space rates

A DECISION UNDER THE GERMAN-AMERICAN PATENT TREATY

In nearly all European countries a patentee incurs a forfeiture for not working his patent within a certain statutory period In Germany and some other countries this period is three years from the date of the patent's issue The United States, on the other hand, has stimulated invention by more liberal laws and imposes no obligation whatever on the inventor to manufacture his invention As a result a German inventor who takes out a patent in this country receives better treatment here than in Germany The status of a foreign patentee is therefore difficult to define When an American inventor discloses a secret, his country grants him a monopoly for a limited period as a reward Once disclosed, all the world is informed of the invention so that a certain injustice results from the fact that he may not be able to comply with the compulsory clauses of German and other foreign patent statutes. A man with more money than he has can thus take advantage of the situation after the expiration of the statutory period of grace The only advantage to a foreign country in granting a patent on an invention which has been patented here is that we in our turn are willing to accord the same rights to citizens of that foreign country It is therefore unfair for us to grant more to foreign inventors than American inventors receive abroad, particularly in view of the fact that no direct benefit is to be obtained from our award for a secret already disclosed

The only solution of the problem is to be found in reciprocity treaties. Such a treaty has been in force between Germany and the United States since August 1st By its terms American inventors are absolved from working their patented inventions in Germany within three years from the granting of the German patent. Heretofore failure to comply with this obligation would result in the loss of the German patent if an action for revocation were brought The new treaty provides in effect that the working of a patent in the territory of one of the contracting parties shall be considered as equivalent to its working in the territory of the other party Hence, an American citizen who works his United States patent in the United States will no longer be required to work his corresponding German patent in Germany in order to avoid forfeiture of his German patent Moreover, since reciprocal rights are now granted by Germany, it would seem that an American inventor who takes out a patent in Germany ought to stand before a German court exactly as he would before an American court so far as forfeiture is concerned In other words, since the United States does not compel him to work his patent, his German patent ought to be good whether he works his American patent or not

A decision has just been handed down by the Imperial Supreme Court of Germany which construes the treaty from the German point of view and which is so liberal in its conclusion that the treaty may be regarded as retroactive in a measure, so as to apply to unexpired patents granted before the treaty became operative. The facts of the case are not all before us, but from what we may glean from press dispatches it would seem that the case involved the forfeiture of a patent which was taken out in Germany by the German branch of an American house before the treaty was signed and which was not worked within the statutory period of three years An action brought to revoke the patent resulted in a forfeiture The present decision the result of an appeal reverses the judgment of the lower tribunal and holds that the patent was not forfeited Before the decision was handed down by the higher court the German branch had transferred its title to the American house but whether this had any effect on the decision we are unable to state because the decision is not before us. Indeed, the status of the German branch is not at all clear At all events, the decision is highly favorable to American inventors and places the German patents of American manufacturers on a most substantial footing.

THE CHERRY MINE DISASTER.

Now that the wave of newspaper frenzy has passed, there may be some of a scientific turn of mind who are anxious to know the real facts of the terrible disaster at the Cherry coal mine

Two large veins in this mine, at three and five hundred foot levels, are good producers, levels known as the 'second' and "third workings." The first is not worked. When the fire was discovered at or about 3 P M on Saturday November 13th, there were upward of three hundred and fifty men in the mine a force about equally divided between the second and third veins Coal was being hoisted from the third to the second level by means of a cage in the ventilating shaft, which is located about three hundred feet from the main shaft At the second level the coal was transferred to the main shaft, and from there hoisted to the tipple The main shaft extends to the third working but it is stopped at the second level by a false floor The cage in the ventilating shaft is operated by a duplex cylinder engine near the mouth at the surface. It never travels to the top of the ground and the engineer controls it only by pressure-bell signal At the main shaft there are two cages whose cables are run to opposite sides of the hoisting drum so that one is raised while the other is lowered. The men of course, take the same course as the coal in going and coming

Without doubt, the signal system at the main shaft is responsible for several lives The engine room of the main hoist is located about one hundred feet from the mouth of the shaft From the engine room a tube runs to the mine, with branches to each of the galleries At the different landings a small air pump is located The stroke of the piston in the pump compresses the air in the tube and causes a small hammer in the engine-room end to strike against a gong The gong is rung once for each stroke of the hand pump at one of the mine landings. A man in the cage obviously cannot direct the movement of the hoist After the engineer has been signaled to haul up the men in the car can give no further signals This arrangement was responsible for the loss of some life

At the ventilating shaft there is located a large-capacity fan which normally runs to deliver air down the shaft at a few ounces pressure. The foul air and gases are then forced up the main shaft in a strong breeze In case of fire it is customary to reverse this fan, in order that fire will not be pushed out into the main shaft where the men are attempting to escape and a signal is arranged to be given from the mine for such an emergency In this particular mine however, where the men must use both the ventilating shaft and the main shaft, the reversal of the fan simply cut off those seeking escape at the former in favor of those at the latter

It is not known who gave the order to reverse the fan but the signal came from the mine The fire had been discovered in the mule barns on the second level between the two shafts and men had begun to come up from the third level to the second, and to make their way over to the main shaft to join those from the second level to be raised to the surface The fan was blowing the fire toward the main shaft. The flames reached the dust-covered pine timbers of the structural work, when the reversal of the fan drew the flames toward the air shaft, thereby setting fire to the timbering there as well Upon the reversal of the fan the main shaft was cleared for a time. Although the cages were bringing up miners on each trip some four men decided to go down and assist the rest in getting to the shaft This was a mistake, for after the trip down, the would-be rescuers were as badly off as those whom they might have been able to save After three or four trips down, and with the rescuers' cage at the bottom the engineer received a bell to hoist away He had started the cage upward when he received a signal to stop, then to lower, then to hoist, then to stop and lower Finally there came a signal to stop The engineer waited in vain for another bell, and after about fifteen minutes he was forced by threats to raise the cage When it reached the surface, it was red hot and the men in it were all dead. The signal arrangement described was directly responsible for the loss of these lives When the men in the cage were ready to be hoisted, one of their number had reached to the pump and given the necessary signal The cage had then started upward, and had proceeded only a few feet when another miner running toward the shaft, saw it and reaching the signal on the landing, brought it back. After he had been taken on board and the cage again started upward a second late arrival repeated the performance By this time the fire had overtaken them, and rendered further signaling impossible The cage should have been kept moving, but the engineer was bound by fixed rules and, moreover, had no way of knowing the conditions at the bottom of the shaft.

The only course left was to seal the shafts and smother the flames, which was done by means of steel rails, planks, and sand. On Sunday morning the seal was broken, and the fire found to be only smoldering. At this time it would probably have been feasible to have entered the mine, full of smoke as it was, with the assistance of oxygen helmets. Once down, it would have been a simple task to have quenched the fire with a good stream of water Instead, the fan was foolishly started, with the idea of clearing the mine of smoke and gas. Common sense could have foreseen but one result. The mine was quickly in flames again, and the hope of saving any of the men who might still be alive was given up

On Thursday several descents were made by way of the ventilating shaft, but the mine remained practically sealed until Friday when the first bodies were taken out Gases or "black damp" offered few obstacles On Saturday, one week after the accident, the miners who had walled themselves up in some of the galleries of the second vein were taken out very little the worse for their long confinement, a living rebuke to the experts of the State Mining Commission, and of the technologic branch of the U. S. Geological Survey, who had declared positively from the first that there were no live men in the mine, and that a day or two more or less made little difference

As a result of the Cherry disaster, the subject of safeguards for mines will receive a great deal of attention It seems many improvements in general mining practice can be made if the lessons taught at Cherry are well learned.

We would make the suggestion that several of the worked-out chambers in each level of a coal mine be fitted up with supplies, food, and water, to last some length of time, that airtight doors of steel be provided, and that pipes from the air compressors on the surface be led to these rooms by way of the shafts. A small amount of air under a few pounds pressure would serve to keep men alive for days and weeks. The expense of such an arrangement would be little

HIGH AND CROSS-COUNTRY FLYING ABROAD

Since the daring high flights of Orville Wright at Potsdam and of Count de Lambert above the Eiffel Tower at Paris (which was also made with a Wright biplane), the other foreign aviators have been striving to outdo these feats of high and cross-country flying. At the aviation meetings in England recently, army officers made determinations with their theodolites of the height reached, this being the first occasion when the altitude of an aeroplane has been officially observed in this way The greatest height reached there was 720 feet, attained by Paulhan on his Farman biplane, but this record was considerably beaten by the same aviator at Mourmelon, France, on the 19th and 20th ultimo. On the first of these two days, M Paulhan, in a 10-minute flight in a wind said to be of 20 miles an hour velocity, rose to a height of 369 meters (1,210 feet), while Latham, on his bird like "Antoinette" monoplane reached 410 meters (1,345 feet), thus making a new height record for a single-surface aeroplane Not to be outdone by his rival however, Paulhan the next day made a new official record of 500 meters (1,640 feet), thus duplicating the height reached unofficially by Orville Wright at Potsdam Besides this, he made a 55-minute flight from Mourmelon to Chalons and back, a distance of about 37 miles, in 55 minutes, or at an average speed of 40 miles an hour In this flight he attained a height of nearly 1,000 feet, and at its termination glided to earth with his motor stopped from a height of about 700 feet. This method of descent, which is that usually followed by Paulhan, is far less dangerous than was that employed by Orville Wright at Potsdam, when he descended at a terrific speed in one-third the time it took him to ascend, and with his motor throttled only slightly, owing to his inability to throttle it down completely He did not stop the motor, owing to his fear of alighting upon women or children (who were liable to run out and let the aeroplane fly over them) in case his machine was not completely under control.

Although Latham has not yet beaten Paulhan's record for height, he nevertheless made a sensational cross-country flight on November 23rd from Chalons to Berru, in order to attend a hunting party. At the appointed hour the monoplane appeared like a swift bird in the sky, circled twice around the field, and alighted in front of the hunting lodge. Latham, gun in hand, jumped out of his machine. After a successful hunt, he returned to Chalons in the monoplane. In addition to these two cross-country flights in France and his flight across Berlin last September, Latham also holds the record for flight in a strong wind as a result of his daring performance at Blackpool, England, on October 22nd, when he flew twice around the course in 10¼ minutes in a strong gusty wind which, according to the registration of a recording anemometer, had a velocity at times as high as [illegible] miles an hour.

[illegible] the [illegible]

[illegible] River project of the [illegible] in Arizona, at the [illegible] per cent of com[illegible]

[illegible] is said to be the largest belt in the world has [illegible] completed. It is 240 feet long and 6 feet wide; it has three-ply thickness, and the cost was $5,-[illegible] hides were used in the construction.

In round numbers there are 1,250 street and interurban railway companies in America, with a total of [illegible] miles of single track and 75,000 passenger cars. The total number of passengers carried annually is [illegible], and the gross annual income is $440,-[illegible].

The monthly report of the passenger-train performance on the New York steam railways for August last shows that 65,312 trains were operated, of which 87 per cent were on time at the division terminals, as against 61,897, or 75 per cent, which were on time in August, 1908.

Continued rains throughout the Isthmus of Panama has resulted in two slides, which occurred in the Culebra cut. The occupants of the houses near by have been removed to safer quarters. The Chagres River has flooded large tracts, and in a number of places the railroad is under water

The French War Office has recently acquired an automobile which is capable of being instantly changed from a land to a water machine. It has a speed of 40 kilometers on land, and 12 kilometers while in the water It can carry four persons, and is actuated by a 14-horse-power motor.

In an address before the American Civic Association, Mr. Herbert M. Wilson, chief engineer in the United States Geological Survey, places the annual damage and waste by smoke in the United States at $500,000,000 in the large cities alone, or about $6 to each man, woman, and child of the population.

A gasoline car is being given a trial on the road leading to the estate of the late Mr Harriman at Arden. The experiment is considered an important one, and it is thought results will prove that the gasoline-propelled car can be used as economically as one propelled by steam on short branches.

Suit was begun in Pittsburg on November 16th by the Krupp steel-manufacturing interests against an American steel-manufacturing concern for infringement of certain patent rights involving the manufacture of armor plate. The testimony relative to the patents used by the defendant concern was given behind closed doors.

The first boats built especially for the 1,000-ton barge canal arrived in New York a short time ago. They consist of a steam-power boat and five barges. They brought down on their first trip a cargo of 63,000 bushels of oats. At present there are only 2,000 canal boats of all sizes in New York State, and of these only 400 are of the first class, even these are rapidly wearing out.

A curious test was recently made on a manganese-steel bank safe by experts. The safe withstood fifteen charges of nitro-glycerine. The explosion of the last charge threw the safe over backward, and blew off the outer layer of the door. It was found that the inner part of the door, however, was but little affected. Unless some more effective method can be tried for opening safes of this type, they may be considered for the time being to be burglar-proof.

An article in Le Génie Civil states that seventy-eight electric furnaces now exist in the steel works of the world, of which thirty-five are on the induction and forty-three on the arc principle. Fourteen are Kjellin furnaces, eleven Stassano, ten Röchling-Rodenhauser, three Elecktrometall Society (Swedén), and one each Colby, Hiorth, Keller, Schneider, and Wallin. There is a steady and marked tendency to increase the capacity of these furnaces, some of those already constructed holding as much as eight to ten tons.

The first regular passenger train through the Pennsylvania Railroad tunnels from Harrison, N. J., under the North River, across Manhattan Island, and under the East River to Long Island City, made the trip on November 18th. This announced the practical completion of one of the most important achievements in American railroading. As the tunnels have not been electrified as yet, the train was pushed through the tunnels by a locomotive. The train was filled with officials, and they were allowed to thoroughly inspect the work, which will have cost nearly $160,000,000 by the time all is completed. All the tunnels will not be open to the traveling public for several months to come. It is probable that the section between the Manhattan station and Long Island will be open to the public by [illegible], and that the whole tunnel [illegible] open by June, 1910.

ELECTRICITY.

The Chicago City Council has recently passed an ordinance requiring that in cases of a delay of over ten minutes on surface or elevated lines, fares must be refunded to the passengers.

Our Vice-Consul General in Calcutta calls attention to the opportunities in India for the sale of small electrical installations in country places. He describes a small plant consisting of a dynamo driven by an oil engine and a storage battery, which is arranged to operate thirty lights and eight electric fans. He urges American electric companies to investigate the subject, as there is a large opening for such installations

The Spiez-Frutigen section of the Bernese Alpine Railway is about to be electrified The power will be obtained from a pair of turbo-generators at Spiez, generating 6,400 horse-power at 15,000 volts. The line will be provided with two locomotives and three motor cars, each car weighing 55 metric tons The motor cars will be required to take a load of 240 tons up a grade of 1.55 per cent, or a load of 160 tons up a 2 7 grade at about 30 miles an hour

A very convenient device for cleaning incandescent lamp globes that are out of reach has recently been put on the market. It consists of a pole provided with a pair of rubber-covered jaws, which may be closed onto the lamp by pulling a cord The lamp globe may then be unscrewed from its socket. The jaws remain closed until a second cord has been pulled In cases where the lamps do not project vertically downward the device is applied to a pole, which is jointed so that the jaws may be inclined to fit over the lamp

Central Park, New York, is to be illuminated with 1,477 electric lamps in place of the 400 gasoline lamps now in use. Three reasons have been given for this change. In the first place, the park is insufficiently illuminated at present, secondly, the use of gasoline has resulted in the destruction of grass around each lamp post, due to dripping or leakage, and finally, the lamplighters have worn paths across the turf from one lamp to another The use of electricity will not require unsightly overhead wires, as the circuits will be contained in armored cables placed underground

The introduction of tungsten lamps is doing much to advance the use of electricity on farms. It is possible for the farmer with a small plant, driven either by a gasoline engine or by damming a small stream to obtain sufficient current to light his house and barn with this economical type of incandescent lamp The use of electricity on the farm, by the way is growing and, as pointed out by the Electrical World, farmers will in time come to consider electricity a necessity Then it will be found profitable to establish central generating stations for farming districts to take the place of the small individual plants now being installed

Experiments have been made in Switzerland showing that the higher altitudes provide exceptionally favorable locations for wireless telegraph receiving stations Messages coming from points within a radius of two thousand miles have readily been picked up in the Alps. This is probably due to the fact that there are few intervening objects between these elevations and the sending stations which would be apt to interfere with the Hertzian waves. It has always been difficult to send messages across the Alps, or even from one part of Switzerland to another over the high altitudes for the reason that the mountains absorb much of the energy

Action has not yet been taken by the Chicago City Council on the question of enforcing the electrification of Chicago's railroad terminals. The employees of the railroad are raising objections to the proposed ordinance. They point to the fact that electrification would increase the danger to railroad men, particularly in the freight yards, claiming that it would be impossible to switch cars without having men standing on the car roofs, and here they would be liable to come in contact with sagging trolley wires, while if the third-rail system were used it would always be a source of danger even though protected One of their principal objections, however, is that they would be in danger of losing their positions.

According to an article in Harper's Weekly, one cent's worth of electricity will make four cups of coffee, or cook a steak, or boil two quarts of water, or make a Welsh rarebit, or operate a 7 inch frying pan for twelve minutes, or an electric griddle for eight minutes, or an electric broiler for six minutes, or run a sewing machine for three hours, or an electric flat-iron for fifteen minutes, or a luminous radiator for eight minutes, or a heating pad for two hours, or a foot warmer for fifteen minutes, or a massage machine for four hours, or a curling iron once a day for two weeks, or a dentist's drill for an hour and a half, or an electric piano player for an hour, or vulcanize a patch on an automobile tire, or keep a big glue pot hot for an hour, or brand electrically 150 hams or raise a passenger elevator five stories a minute or raise 250 gallons of water 100 feet high, or raise ten tons 12 feet high in less than one minute.

SCIENCE.

King Victor Emmanuel recently visited the Baths of Diocletian, which it is proposed to isolate and restore on the occasion of the celebration of the fiftieth anniversary of the proclamation of United Italy The king has approved the project to repristinate the plan of Michael Angelo, who adapted the ancient ruins to the present church instead of building a new façade as was originally intended Thus the ruins will remain untouched The sum of $160 000 has been provided to meet the expense of the necessary work.

The Duke of the Abruzzi has presented the "Stella Polare,' the whaler which he purchased for the expedition to Franz Josef's Land to the Ricreatorio Navale di Roma, an institution founded by the Naval League with the object of training young men both for the merchant marine and the royal navy. The 'Stella Polare," which is at present at Spezia, soon will be brought up the Tiber to Rome and will be anchored off the port of Ripagrande, where it will be used for training students of the Ricreatorio

A physician who has made a careful study of the effects of roller skating has shown that excessive indulgence in this sport frequently results in flat feet, defective development of the leg muscles, and impairment of the gait and carriage of the body Roller skating is especially injurious to growing children, whose muscles, bones, and joints are still in process of development The muscles used in walking, especially those of the feet remain inactive in roller skating, while other muscles are overworked Hence the body becomes more or less deformed especially in the case of young girls who fail to acquire their normal grace and beauty of form

The American Museum of Natural History has acquired about two-thirds of a skeleton of a ceratopsian, a newly discovered species of which the triceratops or dinosaur is a member The skeleton's size is about the same as the triceratops, which it resembles generally The discovery of this remarkable prehistoric animal was made by Barnum Brown of the museum staff who has just returned with an expedition from Montana. The Laramie formation in which the skeleton was found is estimated at 3,000 000 years This species of dinosaur was an herb eater and walked on four feet Its measurements if it is the same as a triceratops, should be about twenty three feet long and about seven feet wide.

Within the next few months radium will be manufactured in London Hitherto the world has had to depend upon Continental laboratories for its radium The new factory has been constructed according to the requirements of Sir William Ramsay, who has devised a method of radium extraction which will, it is claimed, enormously reduce the time now needed for the elimination of the non radio-active elements of pitchblende The more elementary properties of radium in the domain of medicine are becoming fairly well known and hopes are not yet abandoned that by its immediate means one at least of the great and fast-growing curses of modern life may ultimately be arrested It is, in the first instance, for therapeutic purposes that the new English manufactory is now being built.

Lendenfeld has made moving pictures of the flight of insects, with exposures of 1/42 000 second. Cranz has made a kinematographic study of the action of weapons and projectiles employing for illumination electric sparks of a duration of one ten millionth of a second and obtaining pictures of 400 successive phases of the operation of the firing mechanism of an automatic pistol although the entire operation occupied only about one-tenth of a second On the other hand, Kohler has made a series of Roentgen ray photographs of the movements of respiration the time of exposure of each photograph being 15 seconds, during which the breath was held The photographs, after suitable reduction, were joined together in a continuous strip which when used in connection with a kinematographic projecting apparatus, gave a moving picture of the respiratory process.

About two years ago Rutherford discovered that charcoal made from cocoanuts possesses the property of absorbing at ordinary temperature and retaining for a long time the gaseous emanations of radium thorium, and actinium Dr Shober of Philadelphia has attempted to make practical use of this property for medical purposes, especially for the internal application of radio-activity Attempts to use water as a vehicle of the emanation had failed, because water loses its radio-activity very rapidly The experiments with cocoanut charcoal have given very satisfactory results, both qualitatively and quantitatively The charcoal is entirely neutral and permanent, and can be administered internally with perfect safety It can be made very easily and cheaply, has 200 or 300 times the radio-active absorptive capacity of water, and retains its activity for at least two weeks. The administration of the new preparation is very convenient and affords the possibility of producing, in equal or greater degree, all the effects of radio-active spring water

AN ELECTRICAL HOUSEHOLD

BY JACQUES BOYER.

The house which has just been fitted up in the heart of Paris by M George Knap, of Troyes, is the last and most perfect illustration of modern comfort, and although a household of this character is not within the reach of everyone its originality well merits description

After having opened the door, by pressing a button, and confided to the telephone the object of our visit, we are conducted to the dining room If a meal is being served, we are surprised to see no waiter moving around the room The servants remain in the kitchen, and send up every dish at the proper moment. In the dining room is a switchboard with electrical measuring instruments and the necessary keys and commutators The function of each key is inscribed above it in order to diminish the chance of error and a large bipolar commutator allows the switchboard to be cut off from the illuminating circuit Various combinations of lights can be used according to circumstances A large ornamental piece and dishes of fruit adorn the central part of the table, which is strewn with roses in which tiny electric bulbs are concealed This central portion is surrounded by an oval groove which leads to the two silver-plated doors which cover the entrance to the electric elevator The area devoted to the plates and other utensils of the guests is bounded by low parapets of glass and silver Below the table nothing appears except two nickel plated bars which serve to guide the elevator, which is placed in the basement directly under the dining room. One of these bars supports the mechanism which operates the elevator and the crescent-shaped doors above it. On the table, beside the host, are four push buttons When all the guests are seated, the host presses the white button, which causes a little drum to beat in the kitchen Immediately the doors of the elevator shaft open, the soup tureen ascends to the table, and the doors close and conceal the opening By pressing a red button at the right or left, the dish is caused to travel around the table in the corresponding direction It is arrested at any point by removing the finger from the button Other dishes are served in the same manner The function of the fourth button is to cause the dish to rotate, in order to assist the guest in helping himself. When the course has been thus served, the dish is brought back to the elevator by the operation of the buttons, and the drum in the kitchen is caused to strike twice Immediately the elevator doors open, and the elevator descends to the kitchen, whence it returns with the next course, after the plates have been changed

Let us now take a look at the clean and neatly furnished kitchen. The electric range is incased in wood and marble, so that it resembles a buffet. Attached to it are a switchboard, an electric clock a rheostat by which the strength of the current and the heating effect are varied, and an ammeter which measures the current employed in cooking each dish. The range contains four separate electric heaters of polished aluminium, which can be operated singly or simultaneously By means of the electric clock, every dish can be cooked to precisely the proper degree. If, for example, a fowl is placed in the electric oven, it is known from M Knap's experiments that it will require 30 minutes to roast it by radiation The electric contact of the clock is, therefore, set at the figure 30, and at the moment when the desired number of minutes have elapsed, the current is automatically cut off, and an electric bell advises the twentieth century chef that his fowl is cooked to a turn.

Milk is automatically drawn into the stew pan, sauces and cakes need merely to be placed on or in the range, and the current does the rest. The cook can go off and smoke a cigarette without risk of burning his sauces or pastry This method of electric cooking would not be very expensive when the current can be obtained from water power or from the waste power from a large motor

The electric kitchen contains a rotating table, on which are placed machines for chopping meat, churning cream, washing dishes, and other apparatus, driven by a small dynamo. Some curious phenomena may be observed in this electric kitchen. For example, eggs are "boiled" without the use of water, and, in contrast to what occurs in cooking with wood, coal, or gas, a fowl begins to cook at the center, and the skin is not browned until the cooking is finished M. Knap asserts that this method of cooking does not dry out the meat, and gives it a particularly agreeable flavor.

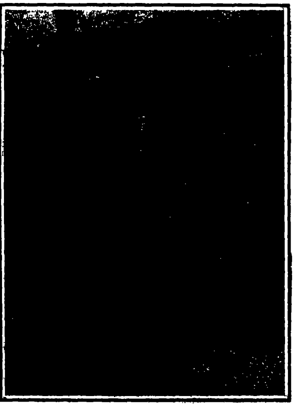
Near the kitchen is a laundry with electric washing machines, electric drying stoves, electric irons and ironing machines, etc.

In the bedroom we find other novelties. The hot-

Arrival of the dish on the table.

The electric kitchen.

The electric dining table.

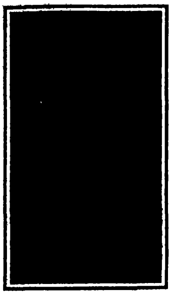


A bedroom in which breakfast is served by electricity.

AN ELECTRICAL HOUSEHOLD

water bag or bottle is replaced by an electric bed warmer containing a small lamp, which is operated by compressing a bulb which hangs above the sleeper's head. In the morning the occupant of the room has only to press a button, and an elevator concealed in a small table will bring him his breakfast and his morning newspaper

Finally, "electric spies," distributed in all the rooms behind the wall paper and the hangings and connected with sensitive microphones, make it possible for the master of the house, by pressing a button without leaving his bed, to know everything that is being done and said in the house.



Fabric for the crayon effect

A landscape printed in the ordinary way.

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SOME PHOTOGRAPHIC DIVERSIONS.

BY GUSTAVE MICHAUD, COSTA RICA STATE COLLEGE.

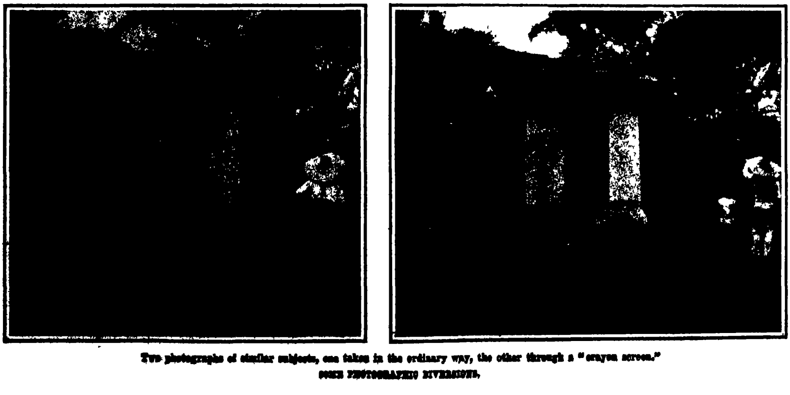
Anachromatic lenses, such as the common spectacle lens, are sometimes used by photographers who aim at the production of artistic effects. The breadth of interpretation observed in pictures made with those defective lenses is a result of the suppression of small details. The impression left by the masses of light and shade is that which is felt before crayon work or oil painting, or before the landscape itself when we enjoy it, that is, when we are not paying particular attention to some minute part of it.

Such artistic effects may be easily obtained with any objective, through the use of two implements, made once for all by the photographer himself, implements for which the names of "crayon screen" and "oil painting screen" would be appropriate

The crayon screen breaks the uniform photographic shades into numberless and irregular dots lines or spots, so that viewed through a magnifying glass they look very much like those produced by crayon drawn over rough paper The screen may be made by copying with the camera and without reduction, a layer of crayon uniformly laid over coarse drawing paper Better results are obtained by copying, with considerable reduction, some irregular design, made of spots, lines, and dots, on a printed fabric such as is found in every dry goods store Herewith is the reproduction in natural size of the fabric used for the making of the screen with which the crayon effect in the accompanying engraving was obtained If the screen is a film, it should be placed in the printing frame between negative and paper If it is a plate it is most conveniently used in the negative holder over the plate, and will then give after a rather long exposure a crayon effect negative Most holders will take and keep in place two plates of ordinary thickness

Same landscape as above made to represent the copy of an oil painting.

Photographs which look as if they were copies of artistic oil paintings may be made with any good negative and the help of the oil painting screen This is merely a negative made from any framed oil painting in which a piece of coarse cloth is substituted for the painting A print is made with this negative It is not toned or fixed and with penknife and rule, the cloth central part is cut out from the print This operation gives two paper masks one of the cloth and one of the frame Printing is made first with the negative of the landscape or portrait with the peripheral frame mask laid on the sensitized paper the holder being placed about normally to the rays of the full sunlight without ground glass but with a glass plate interposed between negative and paper The distance thus introduced destroys the small details, leaving only masses of light and shade The oil painting screen is then used in lieu of the negative It is placed in direct contact with



Two photographs of similar subjects, one taken in the ordinary way, the other through a "crayon screen."

SOME PHOTOGRAPHIC DIVERSIONS.

the paper and frame mask until the canvas effect is clearly seen on the print. Last, the central mask is substituted for the frame mask, and a third printing gives the frame The oil painting effect is the result of the contrast between the small details of the canvas and the seemingly broad technique of the picture over it

How Hydraulic Power is Exported.

The government of Denmark proposes to carry out with the aid of its engineers the following plan Upon the southern shore of the Sund is found the old city of Helsingborg not far from which the Lagu rushes down from an elevated plateau over a stretch of about 30 kilometers. A fall of 100 meters is situated not more than 2 kilometers from the mouth of the Lagu It is at this point and for the purpose of using this important natural motive force, that it has been decided to establish a hydro-electric plant, transmitting its current to Helsingborg (first relay) The submarine cables traversing the Sund permit the distribution of the electric energy produced in Sweden over the territory of Denmark. The island of Seland, in which is found the Danish capital, will be the first to benefit by this installation, which will be very easily carried out, for between Helsingborg (Sweden) and Helsingör (Denmark) the arm of the sea is very narrow, not more than 5 kilometers wide, due to this circumstance the work necessary for the establishment of the submarine cables does not present any insurmountable difficulties.—La Nature

Chinese Wild Silk.

M Francis Marre writing in Cosmos, gives some interesting particulars concerning the wild silk industry of China A certain quantity of this silk, known under the name "water eel, is annually imported into France to be worked up in the factories of Lyons and Avignon, but the greater part of it finds its way to America, where it is made into a stuff called "radjah' Of late years, however, a considerable amount has been employed in the manufacture of balloons a purpose for which it is peculiarly fitted by its strength and toughness

The silk is obtained from a very common Chinese variety of the oak silkworm (*Antherea pernyi*) The larva feeds on the leaves of the *Cudrania triloba*, a dwarf oak which grows plentifully on the hills of Ho-Nan, Süchwan and Kweichou. A warm, moist climate prevails almost all the year round in this mountainous district.

The cocoons of the oak silkworm are treated quite differently from those of the domestic silkworm which is fed on mulberry leaves. They are hung in long festoons sheltered from the sun generally in buffalo sheds, in order that they may be kept at a constant warm temperature They remain thus until the Feast of Spring (at the end of January or the beginning of February), when they are removed and hung up in a large room, of which all the doors and windows are carefully stopped A hole is made in the middle of the roof to allow the escape of the smoke from a stove which is placed in the middle of the room The stove is kept steadily burning for twenty days, at the end of this period the moths emerge from the cocoons and pairing immediately begins, the males and females are then separated the latter being placed in palm-leaf baskets, where they lay their eggs. This operation takes about five days. Each female lays on an average some sixty eggs, which are about ten times the size of a mulberry silkworm s egg After another interval of from fifteen to twenty days, spent in the room which has been closed and heated as before, the worms are hatched and are then taken in the baskets to the places where their food grows The baskets are set down under the dwarf oaks, the flexible young twigs of which are arranged by the natives so as to make it easy for the worms to climb up to the leaves.

The worm feeds for two months, and then begins to make its cocoon, an operation which takes a week. The cocoons are collected toward the close of May, i e, from three and a half to four months after the removal from the warm chamber

The silk is wound and spun in two ways. In the first, which is used to produce a coarse material the thread is spun from twenty cocoons Silk of this kind is manufactured almost entirely at Süchwan In the second the thread is spun from eight cocoons and silk of this kind which is made for the most part at Kweichou, is in greater demand for export purposes

A pound of cocoons produces, as a rule, 240 grammes of fine silk The average price varies from year to year In 1907 it was 15 francs the kilogramme, in 1908, 22.6 francs.

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Denatured alcohol costs more than gasoline and the quantity of denatured alcohol consumed by an alcohol engine as ordinarily constructed and operated is in general relatively greater than the quantity of gasoline consumed by a gasoline engine of the same type It seems reasonable to expect a greater general improvement in alcohol engines than in gasoline engines,

Correspondence.

WHY WATCH SPRINGS BREAK.

To the Editor of the Scientific American

I have read with considerable interest the discussion in the columns of the Scientific American relating to the breaking of main springs in watches. While the writer has had no direct experience along this line, the opinions given, while varying in detail and embodying many outside influences, seem to me to point to a common source, viz., the quality of material used in making the springs

The opinion is constantly gaining ground among steel makers and steel users that the alloys and metallic compounds of iron are vastly more sensitive than those of any other metal, and that the composition and treatment of these substances constitute the foundation for their subsequent success or failure The use to which the steel is to be applied should be known before the steel is made, and its composition as well as the process of its manufacture should be such as to produce the desired results From practical results already attained, the writer is of the opinion that if these springs were made of a high-class crucible vanadium steel, and then subjected to a proper treatment, the trouble from breakage would be reduced to a minimum.

It would require too much of your valuable space to give reasons for this opinion, but I believe that a practical test of the material would lead to valuable results. ELWOOD HAYNES.

Kokomo, Ind

HOW DOES SAP RUN IN PINE TREES?

To the Editor of the Scientific American

In about ninety per cent of all pine trees in this section, the fiber of the sap wood runs in a spiral around the tree contrary to the motion of the hands of a clock, i e., from left to right in ascending the tree This fact is easily observable in trees that have died, and from which the bark has fallen Cyclones in the northern hemisphere revolve contrary to clock hand motion Probably the cause is the same in both cases, liquid sap moving like cyclones It would therefore be interesting to learn whether this fact in regard to pines is universal throughout the northern hemisphere, and in order to determine the fact of identity of cause with the cause of similar direction of revolution of cyclones it would merely be necessary to establish the fact that the fiber of pines in the southern hemisphere ascends in spirals that accord in direction with the motions of clock hands. Cyclones in the southern hemisphere, as is well known, revolve in the opposite direction from that of cyclones in the northern hemisphere

Can some of your readers investigate along these lines, and report results? Does a top spinning in a vacuum weigh less than when it is not spinning? In other words, does the rotation of an object lessen its weight? T C.

Sumter, S C

SAFEGUARDING MINES.

To the Editor of the Scientific American

The recent mine horror in Cherry, Ill., being a sickening repetition of this sample of man's cruel neglect or indifference, emboldens the writer to trouble you with an indication, perhaps, of his ignorance merely, but which seems to him an idea that must have some value He is not a trained mechanic but living in a mining district and reading of the many coal mine accidents he has not been able to forego all speculation on the subject.

It would seem that the energy of the entire body of mining engineers has been given to the problems of preventing mine explosions and other accidents which damage mines and incidentally cost miners their lives I do not recall any efforts of theirs to devise means to safeguard the lives of the miners who are entrapped every time an accident happens. A year or two ago some miners were imprisoned in a mine, and were saved by accidentally finding an old gas or water pipe, through which they communicated with their friends and through which their friends lowered food and drink to them. This fortunate rescue has suggested that for a comparatively small cost a mine room here and there (so situated with respect to size and number and location of them as would ordinarily give refuge to all workers who were not killed outright by the accident) could be so equipped as to give refuge to as many as might be necessary, and harbor them until the mine passages could be opened Why could not such rooms be provided with two-inch pipes, such as the ordinary bored well has, or the smaller hole of the diamond drill if the depth or quality of the rock made it necessary? Through these tubes air could be forced down and the foul air forced out, and food and drink passed down to the prisoners. Such rooms could be supplied with fire-proof and air-tight doors, and each door could have a wicket through which a belated and choking straggler could be quickly admitted. If such a plan would work, surely the cost would be nothing comparatively, even to having a pair of [illegible] pipes going down to each room, [illegible] a strong pumping engine, by means of which [illegible] volumes of air could be constantly forced down. It will be objected that an explosion would destroy such rooms, to which the answer should be, it seems to the writer, "Leave the walls thick enough to withstand the worst of the ordinary explosions."

Surely, if such an idea or device would work, as it seems to the writer it must, the two or three hundred dollars that the equipment of each room might cost would seem a small expense to the mine owner if he had imagination enough to place himself in the place of the owner of the mine at Cherry What would the owner of the Cherry mine give, if it were in his power, to instantly create enough such rooms as would give refuge to the three hundred men below, and be able to tell that frantic rabble of wives and mothers that owing to his foresight, humanity, and money, their men were safely cared for below, and would be fed, and they could communicate with them until the rescuers could release them? Under such conditions there would be no need to sacrifice the lives of those brave fellows who deliberately gave their lives by reason of their very eagerness to help their fellows.

Birmingham, Ala. GEORGE L. BROWN.

AN EARLY MARINE ENGINE.

To the Editor of the Scientific American

The following from an old New York American may be of interest, especially at this time of looking up ancient types of steamships

"In the year 1819, while experimenting for the improvement of the steam engine, my attention was arrested by the great loss of heat under the circumstances in which steam is generally produced, and the idea of my present generator suggested itself to my mind at that time; and in March, 1825, made the first experiment in R. L. Cawdrey's carriage shop, Ithaca, N Y

"I used a blacksmith's bellows to supply the fire with air, and concluded that about eight times as much steam was generated as air forced into the fire.

"The engine (which was installed in a Liverpool packet) is called a 'double steam engine,' having two steam cylinders of thirty five inches diameter, six feet stroke, two blowing cylinders of just half the capacity, which are worked by the engine, and the air is conducted into a boiler whose outer cylindrical case is four feet in diameter and twelve feet high, the furnace, or inner case, is three and a half feet in diameter and nine feet high. The fuel is introduced into it down the chimney, and it is so constructed that not one particle of heat can escape, but must absolutely pass into the water, together with all the gases generated by combustion, and become as strong an agent as the steam itself, passing through the steam cylinders with it."

The inventor, P Bennet, of Ithaca, seems to have had a great deal of trouble with tar in his cylinder, as we would expect, but claimed to have overcome this difficulty WALTER C [illegible]

Holbrook, Mass.

The Current Supplement.

The current SUPPLEMENT, No. 1770 may be regarded as a North Pole number, for it contains two articles on the Pole One of them, by Washington Platt, gives a very complete history of Polar exploration, and shows what terrible hardships have been endured in the past in a quest which has no other reward than that of glory Prof Messerschmitt, on the other hand, contributes a strictly scientific article on astronomical and geophysical conditions at the North Pole. Although scarcely ten years have elapsed since Marconi made his first really conclusive experiment, wireless telegraphy has already become an art. Some recent developments in this art are reviewed by H. Marchand. W B. Huff contributes an excellent article on demonstrations with the musical arc. "On Board the 'Parseval'" is the title of an article by Robert Saudek, in which he describes interestingly a trip in the famous German military dirigible. "Engine Power from Solar Heat" is the suggestive title of an article which will be read with much interest. A hop-picking machine which will have a marked effect on the hop industry is described and illustrated. In view of the return of Halley's comet, which has now been found by the telescope, some account of the great astronomer with whose name the comet is associated may prove of interest to the general reader. J. E. Gore contributes such an article. The conclusion of the article on machines that make cordage, begun in the last SUPPLEMENT, is published. A. E. Shipley tells how zoology is being organized.

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Dr Torp, rector of the University of Copenhagen, has selected Prof. Elis Stromgren, Director of the Astronomical Observatory, as head of the commission to examine Dr Frederick A. Cook's records. These are expected at Copenhagen about December [illegible]

A NOVEL AERIAL RAILWAY.

A German engineer named Leps has conceived a novel and marvelously impracticable mode of transit, a sort of cross between the airship and the electric railway, in which a balloon supports the weight of passenger cars, which run on aerial cables and are propelled by electricity. According to Umschau, whence we derive our information, the balloon is a horizontal cylinder with conical ends of the rigid Zeppelin type of construction. It is about 300 feet long and [illegible] feet in diameter On each side, at the level of the axis, are pairs of small horizontal wheels which move between guiding cables supported by tall latticed steel towers. The function of these wheels and cables is to counteract the force of the wind A wheel on the windward side is pressed against the inner cable, and a wheel or roller on the leeward side is pressed against the outer cable, and thus the stress is equally divided between the windward and leeward towers, and also between the two sides of the balloon.

Beneath the balloon, and attached to it, are the cars, each of which accommodates 60 persons. The cars and connecting passages are made of steel, wood, and canvas, and provided with windows. There is a small forward compartment for the motor and the motorman. The larger compartment is furnished with revolving chairs and folding tables, for the use of passengers. Even toilet rooms are provided. The cars are heated and lighted by electricity, and are propelled by electric motors capable of developing a speed of about 125 miles per hour The motor shaft is extended outward, and each end carries a driving wheel which runs on a propulsion cable. Below this directly-connected wheel and the cable is another driving wheel mounted on a movable axis, so that it can be brought to bear on the cable from beneath. Thus the cable is pressed tightly between the concave rims of the two wheels, producing ample friction for traction, and the car is propelled as on an ordinary electric railway The propulsion cables, which are guide cables as well, are supported by latticed towers, which are shorter and lighter than the main towers, with which they are connected by trusses. An electric cable, suspended between the propulsion cables but at a lower level, furnishes current to the motors by means of contact wheels beneath the cars. The brakes are applied, not to the wheels, but to the propulsion cables.

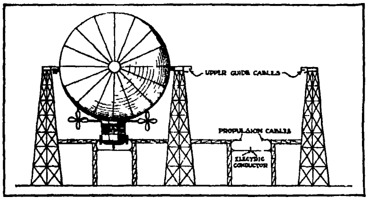


DIAGRAM OF LEPS AIRSHIP RAILWAY

At present this novel railway exists only on paper In order to test the practicability of the scheme it is proposed to construct a short experimental line from Marburg to the summit of a neighboring hill, the Frauenberg, 1,250 feet higher than the Marburg terminus. The promoters calculate that the operating expenses of a railway of this kind would be about one-fortieth those of an ordinary railway, and that the diminution in the cost of right-of-way would reduce the initial outlay to about $30,000 per mile. According to the estimates of the company, a line from Berlin to Hamburg could be constructed for less than $4,000,000, and the English Channel could be crossed at a cost of $5,000,000, while the 6,000-mile journey from Berlin to Vladivostock, which now occupies seventeen days, *via* the Siberian railway, could be accomplished in three days by the Leps aerial railway We would venture to point out that the limited number of passengers which an airship car could carry would mean a prohibitive fare. Count von Zeppelin, we believe, intends to charge $125 for a trip from Switzerland to Hamburg on one of his aeronautic "Lusitanias." Although there may be curious applicants in plenty for airship reservations, it is not likely that railways will suffer from Count Zeppelin's competition. There are engineering as well as financial objections to Leps's scheme. Zeppelin has found it difficult to anchor his airships in high winds. It is probable that storms will play havoc with an enormous gas bag held in place merely by rollers. A railway or foot bridge must be provided with more or less wind bracing if it is of any length, and it would seem that similar provision ought to be made for an airship train. The problem is hardly likely to engage serious attention, for it is not likely that this fanciful road will ever be constructed.

In some metallurgical and chemical operations steam is admitted to large vats or tanks for the purpose of agitating, and, in some cases, heating their contents. In special cases, the consumption of steam for this purpose is enormous. It is often possible to obtain better results by mixing air with the steam This may be accomplished by using an ordinary injector To insure the proper working of the device, the steam is first turned on, then the valve of the injector gradually opened, until the desired amount of air is obtained. By the use of this device, better agitation is secured, the contents of the tank or vat suffer less dilution, and there is a large saving in the amount of steam used.

Destruction of Wood Borers.

BY R. D. HOOPER.

In our waters there are two genera of mollusks, viz., Xylotrya and Teredo, and three of crustaceans, viz., Limnoria, Chelura, and Sphæroma, that attack and seriously damage structures of wood in salt water The Xylotrya and Teredo are very similar in structure and action The former are by far the more numerous, and what are commonly called Teredo are, in the large majority of cases, Xylotrya, and all references to the Xylotrya will be understood to refer to both genera.

When first coming to life the Xylotrya is very minute, being the thickness of a hair and about one-twentieth of an inch long. When very young it attacks the wood in countless thousands, and immediately begins to bore

In structure it is comparatively simple. Its body consists mainly of a tube beginning at the posterior end of the body, running to the head, and then returning to the posterior end. At the head end is a sucker-like foot or tongue inclosed in two shell valves which are provided with fine, hard, tooth-like protuberances It is with these valves that the boring is made. Through the longer end of the tube water is taken in, passed through the body, through the return tube, and is ejected through the shorter end with the wood borings and the excreta. It does not appear that the Xylotrya gathers any sustenance from the wood, its food consisting only of the infusoria in the water

Of the crustacean borers the Limnoria, or "wood louse," is the only one of great importance It is about the size of a grain of rice, and tunnels into the wood for both food and shelter The little galleries excavated are about one-half inch long and extend inward radially, side by side, in countless numbers, so that the wood partitions between them, which are very thin, are soon destroyed by wave action, thus exposing a fresh wood surface to attack.

A new method of destroying these borers has been found The piles to be treated are inclosed by a canvas apron supported by floats, and kept in an upright position in the water by weights at the lower end. The inclosed space is ordinarily not more than 40 x 80 feet square. The water in the inclosure underneath is decomposed by means of an electric current, and chlorine, with small quantities of bromine and iodine, are formed, rising through the water around the piles By a mechanical contrivance the apron and electrical terminals can be lowered to the mud level and gradually raised, the gases being constantly generated in the inclosure. As previously seen, the Xylotrya draws in water through one end of the tube always exposed, which passes through the entire body It has been proven that a mixture of one part of chlorine to one-half million parts of water is sufficient to destroy life in marine animals, so a very small quantity passing through this breathing tube causes death. As the Limnoria obtains a part of its food from the water, the same result is obtained with this type of borer It is true that one application of this method simply kills the borers existing in the pile and surrounding waters, and does not prevent further ravages from others, but the process is so cheap that it can be applied as often as necessary, say every two or three months, thus insuring long life to an unprotected pile.

A public demonstration of this method of destroying wood borers was recently made in the waters of Elliott Bay, the inventors using for the purpose of generating the chlorine gas a current of 100 amperes at about 12 volts.

After the treatment the pile was left in the bay for twenty-four hours, in order that should there be any power of revival it might manifest itself, then it was cut open, and all Xylotrya were found to be dead The result was accomplished principally by the corrosive action of the chlorine upon the exposed parts of the Xylotrya, that is, the so-called "tail" which in reality constitutes both their feeding and breathing organs. It appeared that all exposed tails in the pile thus treated turned white, while when the animal is alive, they are a dark gray As the chlorine penetrated the borer it coagulated the albumen which constitutes part of the body and which shows itself in white spots. The original appearance of the Xylotrya when alive is almost transparent and glassy

The Quebracho Tree of South America.

The quebracho is a tree of South America (Argentine Republic), where it forms entire forests, but nevertheless has been, until now, almost completely unknown. Its use is now beginning to spread among tanneries, and for two reasons First, its high content of tannin, which amounts to 18 to 20 per 100 pounds weight of wood and bark, second, the discovery of chemical methods of treating the extracts, which facilitate the employment thereof It was a German tanner of Buenos Ayres who was the first to find that extracts of quebracho wood were able to tan hides, but the first sample of the wood was carried into Europe by way of Havre in April, 1875 by Dubosc who undertook the industrial manufacture of the extract. The employment of the extract developed difficulties consequent upon the peculiar property of the tannin When one extracts the tannin from the bark by boiling water, the solution deposits on cooling the insoluble tannin, while there remain in solution soluble tannins and the glucosides, or non tannins These three components operate during the tanning the soluble tannins combining with the fundamental substance of the skin, the non-tannin fermenting and giving the acids, which are necessary for "plumping the hides, and which facilitate the absorption of the tannin, the insoluble tannins finally penetrate uniformly into the pores and render the hide impermeable The quebracho is composed of 20 parts of soluble tannins in 100 parts, and only 2 5 of non tannins per 100 while it does not contain any glucosides, it is therefore not able to furnish enough acid by fermentation But if one adds thereto acid liquors resulting from other extracts, there is produced a precipitation of soluble tannin, which renders the tanning process very difficult.

Attempts have been made from the first to eliminate the insoluble tannins by addition of lead acetate, alum, albumen etc and to thus obtain a clarified and decolorized extract, but these attempts have not solved the problem. After that endeavors were made to render the insoluble tannins soluble two Italian chemists, Leptit and Tagliani found that by a treatment with alkaline bisulphites, the non soluble compounds were able to remain in solution and also in the acid liquors This process patented in all countries, has made feasible the universal employment of quebracho In the United States there was employed in 1901 not more than 5,000 tons of extracts, in 1907 six years after the discovery of the bisulphite process, 50,000 tons were consumed, in 1909 70,000 tons The extraction is effected *in situ*, on the Parana River is found a plant producing 50,000 tons per year—La Nature.

Wireless Telegraphy Between London and South Africa.

There are being carried out at this time trials looking toward the establishment of direct telegraphic communication by wireless between South Africa and England, this is being done at Durban in Natal. In spite of the immense distance, it is hoped that a satisfactory result will be obtained particularly since it is known that the propagation of Hertzian waves occurs with much greater facility along the meridians of longitude than it does over the parallels of latitude In undertaking the operation of wireless telegraphy between America and Europe a task was assailed which was really more difficult Fortunately in this latter case, the fogs of high latitudes furnished facilities which may perhaps not be found in the South African line.

Since high towers are very expensive to erect, it is proposed to supplant them at Durban by kites, which will carry to a height of 300 meters the extremities of the antennæ and it has already been estimated that the cost for transmitting messages may be successfully placed at 1 25 francs per word.—Cosmos.

Water Varnishes —Solutions of resin in alkalies and water have been suggested as cheap varnishes but owing to their lack of durability they are used only for common painting Their preparation is very simple dissolve the alkali (soda or potash) in the quantity of water decided on heat it to boiling add the resin gradually in small quantities stirring constantly and clear by standing Floor varnish with shellac 80 parts water, 3 parts crystallized soda 5 parts shellac Floor varnish with shellac and color 20 parts water 2 parts crystallized soda 4 parts shellac, 4 parts washed ocher The varnish is prepared as at first described, the ocher is added after cooling and thoroughly shaken up, and the whole ground in a paint-grinding machine.

HOW TO OBSERVE AND RECORD THE WEATHER.

BY THALSON BLAKE, C.E.

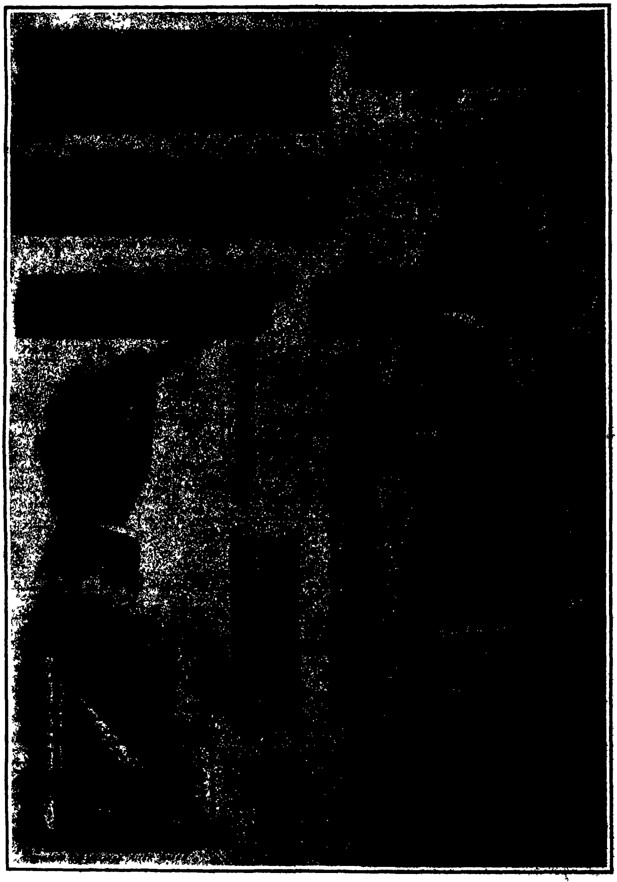
The weather is always with us. Upon its condition depends our physical comfort, our material welfare, our food supply, our outdoor amusements, our sports, and to a certain extent the prosecution of our business enterprises. Because men are so intimately, so profoundly affected by environment, the study of climate is receiving more and more attention from progressive governments.

Each day wears its appropriate dress, summer or winter, and the observation of this daily individuality of the weather constitutes a major part of the duties of weather observers. The United States Weather Bureau forecasts the weather, issues storm warnings, displays frost, cold wave and flood signals, receives, tabulates, and distributes meteorological information for the benefit and safeguarding of agriculture, commerce, and navigation. About two hundred regular observing stations are maintained in the United States and the West Indies, each in charge of a trained observer, who telegraphs to Washington the weather conditions from his local office twice a day—8 A. M. and 8 P. M., seventy-fifth meridian time.

On these observations are forecast the weather conditions for the ensuing thirty-six to forty-eight hours. All of these stations have mercurial barometers, thermometers, wind vanes, rain and snow gages, and anemometers. Many of them have in addition sunshine recorders, barographs, thermographs, that register, automatically and continuously the changes of the weather. The governments of Mexico, Canada, England, Germany, France, Portugal and some others, more or less effectively, maintain similar services so that, by exchange of information, the weather conditions that obtain over North America, North Atlantic Ocean, and West Europe are very thoroughly observed, and forecasts made with dispatch and accuracy.

The art of predicting the most probable condition of the weather for the ensuing twenty-four to forty-eight hours depends on the observations over a considerable area, and on the experienced judgment of the forecasters in predicting conditions likely to follow those at the time of taking the observations.

There seems to be much mystery attached by the general public to the observation and recording of the weather. This supposition is erroneous. The weather itself is seldom complex. At a given hour on any day, it is hot or cold, the sun shines or the sky is overcast, it rains or snows, or there is no precipitation, the air is calm or breezes blow, or there is a hurricane. The weather being reducible to such simple terms, it follows that a comprehensive record of observations need not be abstruse to be valuable. Nor is the observation of the weather by co-operative observers of the Weather Bureau difficult to learn or to take. The great extent of the territory of which it is necessary to have reports, would render impossible any large corps of observers if they all had to be paid. Fortunately, hundreds of people are interested enough to volunteer their services to the government. This enables the Weather Bureau to multiply its observers at little more cost than that of supplying the instruments and the stationery, all of which are lent to responsible and experienced volunteers. The co-operative observers, as a whole, although serving without pecuniary compensation, display much interest and care in their work. Through its principal stations, the Federal government supplies the co-operative observers with thermometers, a shelter in which to house them, and a rain gage. Some may have a larger equipment, but these comprise the customary number.



HOW WEATHER DATA ARE COLLECTED FOR THE WEATHER BUREAU BY AMATEUR OBSERVERS.

It is required of co-operative observers that they read the thermometers once a day, at 7 P. M. The temperature is read on thermometers exposed to free air. Two thermometers are necessary to obtain the highest and lowest temperature, named, respectively, the maximum and the minimum thermometers. The minimum thermometer registers the lowest temperature for the past twenty-four hours. It is filled with alcohol, and its registering of the lowest temperature is accomplished by means of a double-headed, pin-like object, called an index, that slides freely in the alcohol within the glass tube. Solely because the index remains in the alcohol, it is enabled to go down and register the lowest temperature of the period since it was last "set." (Fig. 1.)

For instance, if, during the night, the temperature falls from 35 to 30 degrees, the alcohol column descends, of course, toward the bulb. Then the end, or top surface, meets the head of the index and takes the index down with it. While the index will not suffer the alcohol to pass on down, and leave it in the vacuum above, it will allow the alcohol to flow above it, meanwhile remaining at rest at the lowest point reached by the top of the column of alcohol. It is obvious that because the index will not permit the surface of the alcohol column to flow past it on the way to the bulb, but will lie still when the column of alcohol flows upward with the increase of warmth, the lowest temperature is registered. The maximum thermometer is designed to register the highest temperature of the preceding twenty-four hours. It is filled with mercury, which, owing to a stricture in the tube near the bulb (Fig. 2), can flow freely from the bulb as the temperature rises, but when the temperature falls, it cannot easily flow back. Thus imprisoned above the stricture, it registers whatever degree was the highest attained by the temperature for twenty-four hours.

The words "top" and "bottom" are used advisedly, as the minimum and maximum thermometers are

(Continued on page [illegible].)

TESTING THE MAN-ENGINES

BY JOHN ELFRETH WATKINS.

Of the many man-engine testing plants which have been instituted within recent years the most interesting are those which are now studying the self-directing function of the human machine In these workshops man is continually making surprising discoveries about himself

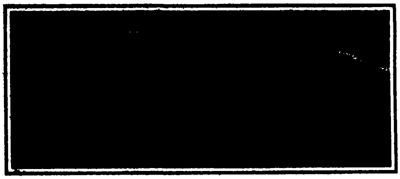
Perhaps the most engrossing item in their equipment is a gage for use in determining the man-engine s speed in starting stopping or directing its course after receiving a signal It is a clock which records thousandths of a second and an electric current can start and stop it within an imperceptible interva Several complicated instruments can be connected with it in such a manner that upon the instant a sound is made a light is flashed or a color a letter or a word is exposed the electrical impulse giving such a signal will start the recording hand

The subject with a finger pressing a telegraph key is told that as soon as he hears sees or feels the signal he must release his finger from the key The signal itself automatically closes the current and starts the clock while the lifting of the finger from the key breaks the current and stops the clock The number of thousandths of a second scored by the clock meanwhile measures the time required by the mind in perceiving understanding and obeying the signal

Thus this man-engine gage will measure the time which you require to recognize or name a letter color or object to read a word or sentence to add subtract multiply or divide to remember your own name your address the meaning of any word in any language Comparative tests thus far indicate that the average mind obeys a sound signal in 125 thousandths and a light signal in 160 thousandths of a second and that the ear therefore is quicker than the eye also that the eye requires about the same time to read a word of five or six letters as to read a single letter that a person remembers his own name more quickly than that of his best friend—even that of his wife that he recollects the country in which his own city is located more promptly than that in which Paris is for instance According to Prof Lightner Witmer of the University of Pennsylvania men hear see or feel signals more quickly than do women and Indians appear to be quicker in this respect than are whites

Of all the man-engine s working levers the arm is the most industrious The quickness of its movements

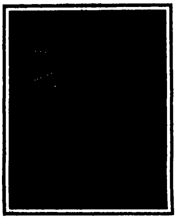
(*Continued on page 4[illegible]0*



Measuring circulation in brain. Asleep head up.

Measuring circulation in brain. Solving a problem Head down

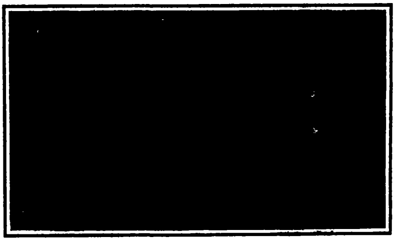
Effects of thought on muscular power



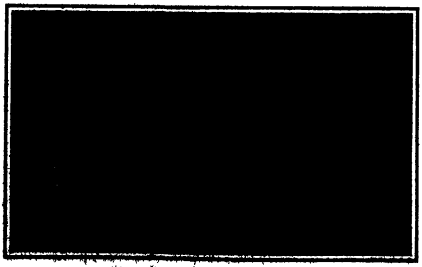
Testing the acuteness of touch

Testing the acuteness of smell

Involuntary hand movements



Measuring lip movements



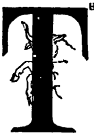
Effects of thought on circulation of blood.

Timing the arm s speed.

TESTING THE MAN-ENGINE.

THE HEAVENS IN DECEMBER.

BY HENRY NORRIS RUSSELL, PH.D.



THE prediction of the return of a periodic comet involves a number of difficulties which are not met with in similar calculations concerning the planets. Comets, especially those of long period, move in very elongated ellipses, and can be observed only when relatively near the sun, since at great distances they are too faint to be detected We have therefore to determine the form and dimensions of the orbit from an "observed arc" which may be only one-tenth or one-twentieth of the whole

A very small error in the observed positions—which may easily occur, especially for a comet which has no sharply defined nucleus—may thus lead to a much greater uncertainty in the calculated dimensions of the orbit, and the resulting time of the next return.

In much the same way a small change in the direction or rate of the comet's motion, such as may be caused by the attraction of a planet near which it comes, may lead to considerable changes in its period, and in the other elements of its orbit. Those changes, unlike the effect of observational error, may be accurately calculated, though only by very laborious processes.

When a comet has been observed at two or more returns the influence of observational errors is greatly diminished, and its future behavior, or its past history, can be determined with a high degree of accuracy

It is thus possible to utilize the ancient chronicles of astronomical events, which have been preserved in various parts of Europe and also in China and to see whether earlier relics of the body under investigation can be identified

It is of course insufficient to find the mere statement that a comet was seen in a certain year, for there are many cases on record when two comets were visible within that interval We need specific information from which the comet's apparent place in the heavens at a known date can be inferred If this agrees with our calculations, or, at least, does not depart from them more than is reasonable to attribute to the errors of naked-eye observations and rough descriptions, the identity of the comet is assured

This procedure has been adopted by Messrs Cowell and Crommelin of the Greenwich Observatory, whose work is noteworthy no less for its practical ingenuity, from the standpoint of the calculator, than for its signal success

Working backward from the last return in 1835, they found returns in 1759, 1682, 1607, 1531, 1456, and 1378 already definitely established by the work of preceding astronomers Those of the sixteenth and seventeenth centuries were the basis of Halley's notable discovery of the periodicity of the comet, which causes it to bear his name The next previous return should have occurred on October 26th A. D 1301, only four days later than the date deduced by Hind from the Chinese observations of a comet in that year The difference is quite within the errors of such rough estimates of position It is noteworthy that the European observations (or at least the existing records) of the same comet are much less accurate than the Chinese—a curious reversal of the present state of things. Still working backward, the returns of the comet in the years 1222 1145 1066 (a famous comet which appeared just before the Norman Conquest of England) and 989 can be identified in the chronicles

At the preceding perihelion passage in 912 there are vague references to a comet or comets, in addition to a bright one which appeared some four months earlier than Halley's could have done but nothing sufficiently precise for identification. On the other hand, the return in 837 is well described, and that in 760 was recorded by the Chinese with sufficient detail to enable M. Laugier many years ago to show from the observations alone that the orbit of this comet, in its visible portion, was practically the same as that of Halley's comet.

The return of A. D. 684 was observed in China and Japan. In 607 at least two comets appeared, one of which was doubtless the object of our study The apparition in 530 is again definitely identified, and the Chinese observations of 451 are by themselves conclusive as to the comet's identity.

Even here the end is not reached. The returns of A. D 373, 295, 218, 141, and 66, all appear to have been observed and also those in B. C. 12 and B. C. 87 A comet observed in China in 240 B. C was probably a still earlier return Beyond this there are no sufficiently definite observations, though a record of a comet seen in B. C. 467 may perhaps refer to a still earlier apparition

This is an impressive record, which may well give rise to reflection—on the indefatigable energy of the computers, and not less on the remarkable care of the ancient star-gazers and of the scribes who preserved their records. But from the standpoint of general interest, it is most of all noteworthy that the comet has been a conspicuous naked-eye object at at least twenty four out of its last twenty-six returns, and probably at the other two, where the records are incomplete. We have therefore very good reason to anticipate a fine sight next May when the comet will be for a few days unusually near us.

At the present apparition, the twenty-fifth which has been certainly observed, the comet is still too faint to be seen without a large telescope, and will remain so until early in the new year In spite of its faintness, its spectrum has been photographed at the Lick Observatory, showing no trace of bright lines or bands, but only a faint continuous spectrum, such as reflected sunlight would give with the instrument employed

The awakening of the comet's activity as it approaches the sun had apparently not yet begun. Its progress will be of great interest.

THE HEAVENS.

There is no time in the year when so many of the brightest stars can be seen at once as at present. Looking first to the westward, we find Altair in the constellation of the Eagle, just setting at the hour assigned on our map, but clearly visible a little earlier Almost due northwest, and a little higher, is Vega, above which is the less brilliant but equally white star Deneb, in Cygnus. The lonely star low down in the southwest is Fomalhaut.

Above this the southern and western sky boasts no very bright stars, but the planets Mars and Saturn are there, close together, in Pisces.

The finest group of all is in the southeast. Low down, and twinkling violently in the winter air, is the splendid Sirius. Above him is Orion which boasts two stars of the first magnitude—Rigel on the right and the ruddy Betelgeux on the left. Due east, and low down, is the lesser Dog-star Procyon. Above on the left are the twin stars Castor and Pollux, and higher still is the brilliant Capella. Across the Milky Way from the last is Aldebaran, the brightest of the stars of Taurus.

This fine constellation, which is shown in our initial, is, like Pegasus, supposed to represent only the head and fore-legs of the Bull. The stars β and ζ on the edge of the Milky Way, mark the tips of his horns. Aldebaran is one of his eyes, and the little V-shaped group of the Hyades, of which it forms a part, marks his face, while the Pleiades are in his neck. Like all the animal-figures in the zodiac, the constellation is of very great antiquity

Of the constellations not already mentioned, we may note the vast and faint areas of Eridanus and Cetus in the south, and the familiar forms of the two Bears and the Dragon beneath the Pole, of Perseus, Cassiopeia, and Andromeda high above us, and of Pegasus to the westward.

THE PLANETS.

Mercury is morning star until the 3rd, and later evening star, but is not favorably placed, and can be seen only at the end of the month, when he sets about 5 45 P. M. far to the south of west.

Venus is also evening star, and is very conspicuous. She is at the greatest elongation (apparent distance) from the sun on the 2nd but is then far south and becomes still more prominent as she comes northward. By the end of the month she remains in sight until after 8 P M and is very bright.

Mars is in Pisces, and comes to the meridian about 7 P M in the middle of the month. He is moving eastward among the stars, toward Saturn, whom he overtakes on the last day of the year, passing about three degrees north of him. By this time he is 90 million miles distant, and only one-eighth as bright as he was in September

Jupiter is morning star in Virgo, rising about 1 A. M. in the middle of the month.

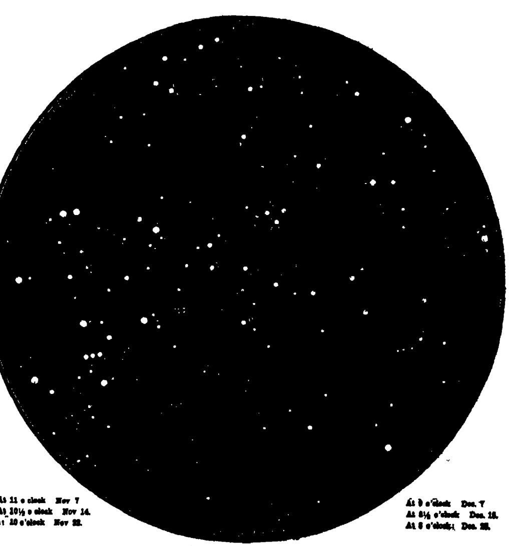
Saturn is in Pisces, near Mars, from whom he can be distinguished by the yellow color of his light. Uranus is in Sagittarius and unobservable. Neptune is in Gemini, approaching opposition, and is visible (with sufficient telescopic power) most of the night.

THE MOON.

The moon is in her last quarter at 11 A. M. on the 4th, new at 3 P. M. on the 12th, in her first quarter at 9 P. M. on the 19th, and full at 4 P. M. on the 26th. She is nearest us on the 23rd, and farthest away on the 7th. In her circuit of the sky she passes Jupiter on the 6th, Mercury on the 13th, Uranus on the 14th, Venus on the 16th, Mars on the 20th, Saturn on the 21st, and Neptune on the 27th.

At the present new moon there is a partial eclipse of the sun, which, since it is visible only in New Zealand and the Antarctic regions, is of little account.

Princeton University Observatory.



At 9½ o'clock November 30.

NIGHT SKY: NOVEMBER AND DECEMBER

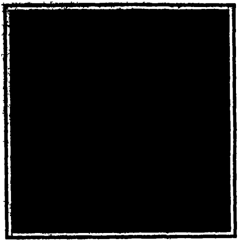
* * *

The Santa Fe Railway Company proposes to electrify the line over Raton Pass for a length of [illegible] miles, between Trinidad, Colo., and Raton, N. M. For this purpose, says [illegible] [illegible] will be required for [illegible] hauling goods [illegible] Mountains. The [illegible] involve an expenditure [illegible]

CURIOSITIES IN SCIENCE AND INVENTION.

PEDALING ON WATER.

Every once in a while an inventor comes forth with some new contrivance for traveling over water, which though of no practical utility is interesting because of its novelty or oddity. Pictured herewith is a very queer craft comprised of three floats which support a bicycle frame. The navigator sits on the bicycle seat, operating the pedals in the usual way, and the latter are geared to a screw propeller, which drives the craft forward. The front float serves as a rudder As progress is rather slow, a small sail is provided, which is attached to the forward float of the craft.



A CURIOUS SAIL AND PEDAL PROPELLED CRAFT.

◆

THE ICE DRAG OF THE WELLMAN EXPEDITION

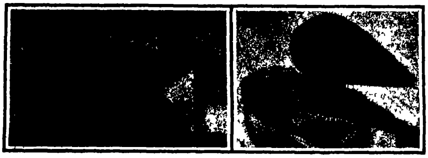
One of the curious contrivances gotten up for the Wellman airship expedition to the North Pole was a drag that would retard backward drift when the airship was encountering head winds too strong to permit of anchoring It consisted of a long leather tube, armed with steel spurs adapted to dig into the ice, as it trailed over the surface The tube also served as a reservoir for food It was ingeniously figured out that as the balloon gradually lost its lifting power because of the leakage of gas, the drag would also become lighter because of the consumption of food, and thus its dragging effect would always be proportional to the weight of the airship.

AN ICE DRAG FOR AIRSHIPS.

◆

AN EARLY TYPE OF SUBMARINE BOAT

Whenever a prominent invention is reduced to practice, the inventor finds his claim to originality called in question by the work of some obscure inventor living generations before. It does really seem as if there were nothing new under the sun. In the early part of the last century a friend of Herr Leeghwater, the celebrated Dutch engineer, spent all his fortune and ran deeply into debt by constructing a model of a submarine boat. Illustrations of this remarkable submarine are shown herewith. The boat was of porpoise shape and was designed to be driven by four men turning a fly wheel The latter operated fan like valves working in the orifices under each bow, thereby drawing in water, which afterward was forced out in jets by means of pistons also operated by the fly wheels. The boat was trimmed by means of weights moved along the tramway shown at each side The conning tower was telescopic so that when diving far below the surface, where the pressure of the water would be too heavy on the glass windows the tower could be collapsed. Unfortunately the name of this early inventor has been lost.



Model built early in the last century

Cover of the model removed to show the mechanism within

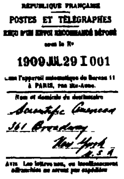
AN EARLY TYPE OF SUBMARINE BOAT

◆

COIN-OPERATED DEVICE FOR REGISTERING LETTERS.

In one of the city post offices in Paris there is an apparatus which automatically registers letters, and issues a receipt for the sender of the letter The apparatus is arranged to receive the French nickel or 25-centime piece Advantage is taken of the fact that it is slightly magnetic, for in passing down the coin chute it is obliged to leap a gap and is prevented from dropping through by means of a magnet. A counterfeit of iron cannot pass the gap because it would be lifted up by the magnet, while non-magnetic coins would fall through The letter slot does not open until after the coin is placed in the machine, and the receipt is not issued until after the letter is placed in the machine The receipt, in the form of a ticket is dated and stamped by turning the crank at the side of the apparatus. The whole operation is performed in less than five seconds, and is calculated to do away with the long line of waiting applicants at the usual registering windows. The apparatus can also be placed in banks or stores, where there is no danger of its being stolen thus relieving the pressure at the regular post office

The apparatus used in a Paris post office.



RÉPUBLIQUE FRANÇAISE

POSTES ET TÉLÉGRAPHES

REÇU D'UN ENVOI RECOMMANDÉ DÉPOSÉ

sous le N°

1909 JUL 29 I 001

dans l'appareil automatique du Bureau 11

À PARIS, rue Ste-Anne.

Nom et domicile du destinataire

Scientific American

361 Broadway

New York

U.S.A.

Avis Les lettres non, ou insuffisamment affranchies ne seront pas expédiées

Facsimile of receipt issued by the machine.

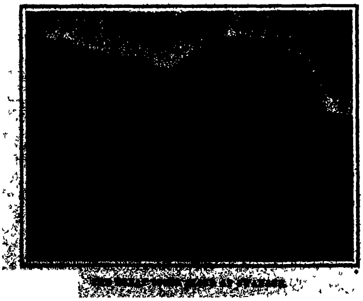
Interior mechanism of the letter registering apparatus

COIN-CONTROLLED APPARATUS FOR REGISTERING LETTERS.

◆

THE GREAT STONE GLOBE AT SWANAGE.

A peculiar monument is set up at Swanage Dorset County, England It consists of a globe 10 feet in diameter and weighing 40 tons. On it the continents and oceans are shown, the former in slight relief Carved in the globe are the meridians, parallels of latitude, ecliptic, and tropics. The axis of the globe is inclined to correspond with the inclination of the earth's axis with respect to the ecliptic, but unfortunately the inclination is not in the right direction Were the axis of the globe parallel with the axis of the earth, observers would be able to get a correct idea of day and night in different parts of the earth when the sun is shining on the stone globe. The monument is intended as a lesson in astronomy Engraved on tablets of stone about the globe are data concerning dimensions of the earth, etc



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We have not heard the last of the "Mauretania's" great steaming powers and performances Toward the end of the year when the passenger season slackens down, the Mauretania will go into dry dock and be fitted with new propellers designed at Wallsend and specially intended to utilize the vessel's reserve of engine power which has not yet been called into full play The propellers are similar to those which have recently been fitted to the Lusitania ' and with such good results that the vessel immediately broke the record The Mauretania however soon responded, and went one better even with her old propellers. With the new ones when fitted it is naturally expected that she will do still better Indeed the builders and engineers of the Mauretania' anticipate making her a 26-knot ship at the least for her special advantages in design and engine power will be brought out to their full capacity —The Mariner

SPRAY HELMET FOR FIREMEN

Firemen frequently find it necessary to play the hose on their fellow firemen to protect them from the intense heat of the conflagration which they are fighting Borrowing from this idea an inventor has devised a helmet formed with a spray nozzle which is connected to a small hose line The water spouts out from the nozzle in all directions causing a miniature cascade around the body of the fireman enabling him to attack at close quarters fires that would be unendurable under ordinary conditions

FIREMAN PROTECTED BY A SPRAY HELMET.

INDOOR BED TENTS.

BY KATHERINE LOUISE SMITH.

Fresh air at night and plenty of it is the cry that is going up among those who are determined to subdue the "Great White Plague," and with these persons it has become more than a fad, a necessity. Those who have resolved to abstain from kissing even their nearest and best, are now either seeking some practical method of sleeping out of doors, or planning some device whereby a good supply of fresh air may be obtained in warm bedrooms. Many persons are building screened porch bedrooms just outside of the sleeping rooms, where they can sleep in the patent sleeping bags that leave only the head exposed and that come with pockets for holding the hands. These persons dress and undress indoors, and jump into their twenty-dollar sleeping bag after adjusting a warm hood and muffler. But though the muffler can be drawn over the head so that only the eyes are exposed, and though it is made of heavy wool and elastic, there is in this outdoor sleeping bag danger of catching cold between the warm room and the outside bed.

So these fresh-air enthusiasts are casting about for some method that shall keep the body warm, the head exposed to the fresh air, and the bed adjusted in such a way that undressing and passing to the bed can be conducted in a warm room. To fill this need several devices have been invented, but they all fall under two heads—one where the person sleeps with his head out of the window, and the other where the bed is rolled to the open window, and a tent employed to drop over the sleeper's bed.

The cost of the ordinary window bed is moderate. It can easily be made by any carpenter, as it is constructed of an ordinary hospital bed with the legs adjusted eighteen inches from the end. These are just long enough to raise the bed so it can go over the sill. The head of the bed at night is thrust through the window, the sleeper creeps into the bed with his head outside the window and draws an awning down over his head, which protects him from inclement weather and at the same time does not exclude the air. A wide strip of felt is fastened to the lower sash of the window to keep the air out of the room. In this way the sleeper has his head outdoors and his body under the bed clothes in a warm, heated room. There are however two objections to this bed though it is so simple it can be made at home. These are that in cases where it protrudes through a window above the first floor, there is often the uncomfortable sensation that one may fall, and the other is that the bed shows from the outside of the dwelling.

For these reasons many persons are using the new fresh-air tents which are fastened inside the window. While several varieties are made, they all involve similar principles of construction, and they have the merit of not being conspicuous. In using the window tent, the side of the bed near the top is placed next to the open window. The tent, which is made of heavy canvas or awning cloth, comes down from the inside of the window over the side of the bed and over the pillow. It reaches to the middle sash and can be adjusted by tightening a screw, and is capable of being moved from one window to another. With the head once under the tent, one can actually breathe the fresh air from the window, while the rest of the body is in the bed covered by the bed clothes and in a warm room.

These tents have become popular for they are large enough so that the face can be close to the window or on the pillow and three feet back. A little celluloid window in the side of the tent next to the room allows the user to look out and to converse with those

(Continued on page 423.)

AN EMERGENCY OXYGEN USE FOR MINERS.

BY [illegible]

Clarence Hall, explosives expert for the government, has just announced the invention of a safety device which, had it been in use a few weeks ago, might have saved hundreds of lives at the mine of the St. Paul Coal Company at Cherry, Ill. The device is a simple appliance, which generates sufficient oxygen to sustain life for a half hour or so under any conditions of atmosphere. Had the miners who died in the recent disaster been supplied with this apparatus, the densest of smoke or an atmospheric condition entirely devoid of oxygen would not have killed them. They would have been enabled to remain alive until the supply of oxygen was exhausted.

MINER'S EMERGENCY OXYGEN OUTFIT.

The newly invented oxygen generator guarantees a lease of life for a time ranging from a half an hour to an hour while a man is fighting his way to the open air or awaiting the coming of rescuers. The invention was made by Mr. Hall while in the government service. The manner in which the inventor hit upon the idea of supplying oxygen to the entombed miner was casual in the extreme. Mr. Hall was lighting the lamp of an automobile, when the thought occurred to him of generating oxygen as the gases of the lamp were generated, and supplying that oxygen to miners to breathe when the air of the mine had become so contaminated with poisonous gases and smoke as to spell immediate death. Accordingly he made a device which consists of a water chamber, and below it a compartment filled with sodium peroxide. In an emergency, a stopcock is touched, and the water comes in contact with the chemical. The oxygen is generated. This is passed through the water, which cools it. Then it passes to the mouth and nose by means of a mask, such as is fitted to the face when gas is ordinarily administered by a dentist. Thus may oxygen be supplied that will keep a man going for half an hour while he fights his way out of a mine filled with gas or smoke.

Mr. Hall as a representative of the government studied many of the great disasters in mines that have occurred in recent years. At Mononga, where more than three hundred men lost their lives in December, 1907, he found that the vast majority of the men had died by slow suffocation long after the explosion. Many of these had crawled for great distances on their hands and knees, for the miner knows that the best air is near the ground. Their trousers were worn through at the knees, and their blood marked their trails. Their fingers were worn through to the bone from crawling.

Of all men who die in mines, ninety per cent meet death through suffocation. There are in the United States 700 000 men who work in coal mines. Many of these are daily subjected to the danger of suffocation. Every year 4,000 of them go to their deaths in this way. The ordinary safety devices are expensive. The men cannot have them always at hand, even if they could afford the expense.

The new device can be slipped into the coat pocket, and kept with the coat and lunch basket, always within reach.

Mr. Hall is in charge of the explosives station in Pittsburg, recently described in the SCIENTIFIC AMERICAN SUPPLEMENT. That station, it will be remembered, has a large chamber in which all sorts of poisonous gases may be confined and into which men are sent to demonstrate various appliances. Various kinds of oxygen helmets which will keep a man going for two hours were tried out here.

In this demonstration chamber Mr. Hall burned excelsior in the chamber until the smoke was so thick that the eye could not see four inches through it. Then he donned his oxygen-producing device and went in. He remained here quite comfortably for fifteen minutes. Then the smoke pained his eyes and drove him out. The device continued to generate oxygen, and other men entered the chamber with entire safety for more than half an hour.

A New Chromatic Circle.

The principal purpose of a chromatic circle is to show the true complementary color corresponding to any given tint. Rosenstiehl has attempted to correct the old error of regarding red and green, yellow and violet, blue and orange, as pairs of complementary colors. These false notions were introduced by Robert Waring Darwin at the close of the eighteenth century. They have been perpetuated by the chromatic circle used in the Gobelins tapestry manufactory and popularized by a lithographic copy of that circle, made in 1861, which is the only document at the disposal of French artist-artisans.

Rosenstiehl's experiments show: First, that the true complementaries of red and orange are not green and blue, but two tints near together in the green-blue region, second, that the complementary of yellow is not violet, but blue, third, that violet is the true complementary of green. The differences between the true complementaries and the false complementaries of Darwin are sufficiently great to warrant the construction of a new chromatic circle. Rosenstiehl's circle comprises twenty four colors, which form twelve exactly complementary pairs. A neutral gray is produced by the rotation of a disk, half of which is covered with each color of any pair of complementaries, and all the grays thus obtained are very nearly identical. This condition, very difficult to realise in practice, implies not only equal intensities of the two colors of a pair, but sensibly equal intensities of all the colors. The result is in accordance with the Young-Helmholtz theory of the three fundamental color sensations.

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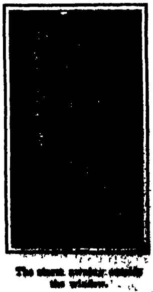
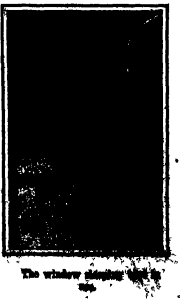
The first bituminous coal mined in the United States, states the United States Geological Survey, was taken from what is usually termed the Richmond Basin, a small area in the southeastern portion of Virginia, near the city of Richmond. This basin is situated on the eastern margin of the Piedmont Plateau, 13 miles above tide water, on James River. It lies in Goochland, Henrico, Powhatan, and Chesterfield counties. The coal beds are much distorted, and the coal is of rather low grade, when compared with that from other districts with which it has to come into competition. The occurrence of coal was known in the Richmond Basin as early as 1700, and in 1789 shipments were made to some of the Northern States. In 1832 the production amounted to 48,215 gross tons. At present what little coal is produced in this field is for local consumption only.

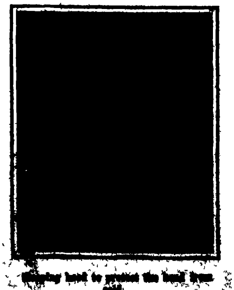
Storm awning raised, showing the sleeper in the indoor bed tent.



The storm awning [illegible] the window.



The window sleeping tent in use.



[illegible] hood to protect the head from cold.

INDOOR BED TENTS.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

SEPARABLE FASTENER FOR BOOTS AND SHOES.—J. [illegible], Salt Lake City, Utah. One of the purposes of this invention is to provide a simple, durable and effective means for drawing together the upper of a boot or shoe from the top of the vamp, and holding the upper closed over the front of the foot from the instep to the ankle.

COMB.—W Jacobs, New Orleans, La This invention is an improvement in combs, being adapted for embodiment in ladies' dressing and back combs as well as in pocket combs for use by men. The article presents an attractive appearance and combines with a comb, a mirror conveniently arranged for use as desired

BUCKLE.—A. Birnbaum, New York, N Y The buckle is more especially designed for use on men's trousers belts, and arranged with a particularly shaped hook on the tongue, for engagement with the fastening device used for closing the flies of the trousers, to hold the belt against upward movement on the trousers.

Electrical Devices.

ELECTRIC PROCESS FOR MAKING PICTURES.—B D Avis, Jr, Wallace, W Va. In the present patent the invention has reference to picture making, and the more particular purpose is the provision of a method and means for developing by electrolytic action a sensitive plate or analogous member which has been previously affected by the action of light.

VISUAL-SIGNAL APPARATUS.—R Einbigler, New York, N Y The object here is to provide an apparatus for use in stock exchanges, factories, and mercantile establishments, and arranged for summoning a person to a meeting place by displaying the person's name number or other indicating character, and also a station or place to which the person is directed for meeting the caller It relates to apparatus such as shown and described in Letters Patent of the U S, formerly granted to Mr Einbigler

Of Interest to Farmers.

COMBINED FERTILIZER DISTRIBUTER AND PLANTER.—F W Decker, Brunswick, Ga This device has the advantage over the ordinary type of planter in that the work in carrying out the operation is materially reduced To this end a two wheeled machine is provided which is capable of delivering the fertilizer, drilling the ground preparatory to planting the seed, depositing the seed in the drill, and covering the seed after planting

CORN PLANTER.—C W Landram, Hustonville, Ky, This invention includes a special construction of main and auxiliary frames, the auxiliary frame being arranged at the front and pivotally supported. It carries the seed boxes and dropping mechanism. The various novel details characterize the adjusting and controlling means for the auxiliary frame and the parts carried thereby

Of General Interest.

PAPER DECORATION.—A Simonson, New York, N Y The invention pertains to decorations or festoons, and the intention is to provide a collapsible paper festoon formed of a plurality of layers of tissue paper or similar material, so cut and pasted as to be readily expanded for use as a decoration or garland.

INTERLOCKING BUILDING BLOCK.—B Benas, New York N Y The purpose of the inventor is to provide a new and improved interlocking building-block, for forming walls, partitions, floors and like structures, and arranged to interlock endwise and sidewise with adjacent blocks to form an exceedingly strong and durable structure

SUBMARINE MINE.—A. P. Broomell York, Pa. In the present patent the invention is an improvement in submarine mines or torpedoes and it has for an object the provision of a novel method of placing the torpedo at the desired depth below the surface of the water and a novel construction whereby the mine is so placed.

SIGN.—R. C. Lafferty, Clarksburg, W Va. In this case the improvement is in signs, and while the invention has a general application and is capable of general use it is especially designed for use as a memorial sign by fraternal and other societies by which to display the names of the deceased members, and as a directory for office buildings.

DEVICE FOR LOWERING LIFE-BOATS.—C. J Christophersen, New York, N Y. This appliance is for use in controlling the lowering of life-boats from the davits of ships or vessels, etc., and the invention has for its purpose to facilitate the launching of the boat and avoid the wearing on the ropes incident to passing the ropes about cleats and permitting them to slip thereon under the weight of the life-boat, as is the usual practice.

APPARATUS FOR VIEWING STEREOSCOPIC OR OTHER PICTURES.—J Richard, 25 Rue Mélingue, Paris, France. The apparatus comprises a horizontally movable carriage carrying a holder or magazine whereby each view in succession is brought into the plane of an upright frame which is capable of being moved vertically to bring one view at a time opposite the eye pieces of the instrument and thereafter return the view to the holder.

[illegible].—E. [illegible], New York, N. Y. This invention relates more particularly to that type of metal adapted for use in supporting pictures, mirrors or the like, or for use as the back of small picture frames. One object is to simplify the construction of the hinge or connection between the back plate and the brace, whereby lost motion between the parts will be eliminated, yet they may be moved relatively to each other with minimum friction.

PROCESS OF RECOVERING TIN FROM WASTE.—A. Nodon, 12 Rue de Moulis, Bordeaux, France. The object in this case is to provide an improved process for the recovery of tin from all kinds of tin lead waste, and more particularly from waste tinned plate, waste lead tin alloy and plated goods resulting from the manufacture of metal "tin capsules," "tin foil" and "tin tubes."

MOLD.—J R. Kay, New York, N Y An object here is to furnish a mold for forming monolithic bodies of concrete, cement, and the like, which comprises removable and separable parts which can be easily mounted in position and taken down, and which is fashioned from standard structural members of metal or other material.

Hardware.

SAFETY-RAZOR BLADE HOLDER.—D. Conrein St. Petersburg, Fla The invention is especially designed for use in stropping the blade and is so formed as to place the edge to be sharpened at the proper angle for the stropping operation The holder is also made in one piece from a blank and presents a simple economically produced and effective holder for the purpose

FARRIER'S IMPLEMENTS.—W Rawalt Blandinsville, Ill. This invention relates to an improvement in farrier's implements, by means of which a horse's hoof may be quickly and properly trimmed. The object is to provide a tool with a chisel and a movable hammer head, whereby the chisel may be more readily operated to trim the hoof.

VIBRATORY DISINTEGRATOR FOR GAS-PRODUCERS.—J J Astor, New York, N Y This invention relates to certain improvements in the manufacture of producer gas and the object is to render practical the manufacture of producer gas from peat The main essential feature involves the disintegrating action on the peat caused by the expansion of the gas occluded in the peat or held within its pores and interstices.

Heating and Lighting.

HEATING APPARATUS.—R. B Smith, Scotland Ontario, Canada. The inventor's purpose is to provide in combination with a boiler or casing, a combustion chamber in connection with the exhaust of an internal combustion engine for complete burning of the gases, and arranged near the bottom of the casing, an exhaust pipe leading from the chamber, having radiating means, as a coil, located adjacent to the chamber and means for introducing water within the casing surrounding the chamber, and radiating means.

LIGHT-CABINET.—C F McClure and W L Shuman, Sullivan, Ill The purpose of this invention is to produce a device which upon the release of a trigger, will ignite a piece of absorbent cotton or similar material, and permit it to move by gravity along a wire or other suitable guiding means to a place where the illumination or combustion is desired

LAMP-CHIMNEY.—G H Lee, Omaha, Neb. This invention relates particularly to means for centering the chimney of a lamp when it is set in position An object is to provide a chimney having means which will facilitate its being guided to its proper position on the burner without necessitating the exercise of great care

Household Utilities.

SELF HEATING FLAT IRONS.—C. S. Konigsberg and W Allen, Oakland, Cal. This invention relates to irons adapted to generate the vapor or gas by which they are heated. One object is to produce an iron adapted to use denatured alcohol and the like for the heating agent, and having a supply tank formed in the lower portion of the handle of the iron.

QUILTING-FRAME.—S. S. Russell, Columbia, S. C. This invention is an improvement in quilting-frames, and particularly in folding quilting frames. Means provide for adjusting the frame at any angle; provide for securing the extension bars in any adjustment desired and permit them to slide in adjusting relatively to the main bars, and provide for operating to draw the uprights toward each other to securely brace the frame when in use, and also to separate the frame for convenience in storage and shipment.

Machines and Mechanical Devices.

PLUNGER MECHANISM FOR OIL-WELLS.—L. R. McCarthy and J C. Vrohan, Spartansburg, Pa. This improvement pertains to the construction and operation of oil wells and the like, and concerns itself especially with the construction and operation of the plunger mechanism. The purpose is to provide a construction for controlling the pawls which lock the collar in the pipe.

SAW-CARRIAGE.—P J Murphy, Alexandria, Va. This device, while permitting the easy manipulation of the saw-carriage, and the adjustment of the stick of wood to the proper length, prevents the saw from coming in contact with the operator's hand. The guard may be raised or lowered to any convenient height and retained in position to permit adjustment of the wood in place for sawing.

ETCHING-MACHINE.—H Schmidt, New York, N Y This invention has reference to etching-machines of the type in which a plate or other article to be etched is exposed to the action of free acid in a trough The invention causes the acid to produce a maximum effect and yet prevents the actual contact of the paddles with the surface to be etched

GRIPPER FOR PRINTING-PRESSES.—M. W Alger and C. L. Jacobson, Benton Harbor Mich. The objects here are to provide adjustable fingers or grippers having horizontal adjustment to provide fingers to hold the sheet being printed at the top and bottom of the sheet to provide grippers to grasp at intervals the sheet to be printed, and to provide a mechanism simple and economical in construction and efficient in operation

FILLING DEVICE.—J Parish, New York, N Y The aim is to provide in this instance a device by means of which powders crystals or other granular material can be expeditiously and easily introduced into small necked bottles and the like, which requires little effort to operate it, and which fills the receptacles without spilling any of the material which is being introduced into the receptacle.

Prime Movers and Their Accessories.

SPARK-PLUG FOR INTERNAL-COMBUSTION ENGINES.—M Exquem, 101 Boulevard Pereire, Paris, France The invention relates to an improvement in a spark plug with a tubular electrode and a decompression cock for the purpose of producing the cleaning of the plug not by means of the burned gases, but by fresh gases, that is to say by air containing particles of gasolene. It is essentially characterized by the application to the plug of a device to cut off the ignition when the above cock of the spark plug is opened.

Railways and Their Accessories.

CAR DOOR FOR GRAIN COAL, ETC R R Reavely, Fort William Ontario Canada The construction embodies two doors hinged at the side edges to swing outwardly and forming, when closed, a substantially triangular opening, with the point of the opening at the bottom a third door for closing the opening hinged at the top to swing inwardly and with the two doors removable from their hinges to swing to the outside of the car below the floor or carried within the car to positions removed from the door opening and the third door removable to the top of the car

CAR FENDER.—T J Kitteen, Portland, Ore The purpose of this inventor is to provide novel details of construction for a fender particularly well adapted for use on a street car and that afford a strong automatically operating car fender, which when in position on a car, will positively pick up and support a person struck by the car without doing serious injury thereto.

ELECTROMAGNETIC TRACTION SYSTEM.—G L. Stanberg, and A D Wagner, Norfolk Va The object of the improvement is to provide a surface contact railway system which will have all the advantages of such a system and adapted for street service in cities as well as suburban traffic. Heretofore such systems have not been successful being only applicable to short lengths of track in factory yards and the like

SEAL-LOCK.—E. L. Pitts Yuma Ariz. Ter In this instance the improvement is in seal record devices The object of the invention is to provide a device for use on railroad freight cars, registered mail sacks etc whereby a continuous and permanent record of the times the car is opened and closed may be obtained.

Pertaining to Recreation.

FISH HOOK.—W E. Koch Whitehall, N Y The invention relates to hooks of the gang type such as shown and described in Letters Patent of the U S., formerly granted to Mr Koch The aim is to provide a hook arranged to dispense with the lead weight on the main hook and to counterbalance the hook with a view to securely holding the live bait floating in a natural position, and to keep the main hook and gang hooks in proper relation to each other

Pertaining to Vehicles.

LOG-WAGON.—W M. Norris, Edwards, Miss Log-wagons require to have great strength and durability along with maximum lightness and easy draft, besides being adapted to turn in a comparatively small circle Eight-wheel wagons are preferable but they have certain objections or defects which this invention removes by improved construction arrangement and combination of the parts.

WAGON DUMP.—E. Ewel, Grand Island, and S. L. Clement, North Loup, Neb. This improvement is particularly adapted for side dump wagons, and means are provided whereby the main chute will receive and support the wagon body when the latter is in dumping position, and means for holding the chute at such time in discharging position and for releasing it from such position after the load is dumped.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper

Notes and Queries.

HINTS TO CORRESPONDENTS.

The full name and address must accompany all letters, or no attention will be paid thereto. This is solely for our information *All* queries are answered by mail, and a *few* of the selected answers are afterward published in the paper We cannot undertake to furnish information on matters of personal interest without reasonable compensation To answer questions which are not of general interest usually costs us from \$2.00 to \$3.00 each upward, and this sum should invariably be remitted in such cases. When there are questions involving building or other construction or when calculations must be made an estimate of the cost will be furnished upon request We cannot give answers to examination papers or decide wagers, nor can we undertake to solve mathematical problems of any description whatsoever Do not use postal cards.

Queries from this vicinity not answered within fourteen days should be repeated in full Queries from points more remote will require a longer time

We do not make chemical analyses but we are always pleased to give the names of minerals which are submitted to us, when it is possible for us to do so. The minerals should be sent marked distinctly with the name of the sender, and should be sent fully prepaid.

Buyers wishing to purchase any article not advertised in our columns will be supplied with the addresses of the houses manufacturing or carrying the same as soon as possible, or if we are unable to do so, their queries can be advertised in our special classified column

Any books on any scientific or technical subject can be furnished We solicit requests for quotations. The Scientific American Supplements referred to are mailed for ten cents each. Book and Supplement catalogues will be sent free on request A careful reading of these "Hints to Correspondents" will prevent any misconception as to the uses and will prevent abuses of this column.

(12148) R. H A. says I tried the experiment of renewing old dry cells and proved to be a failure which was on page 300 of the October 23rd issue The chemical did not want to absorb and took two days before I was able to get the right quantity into the battery, and when sealed up tested about 7 amperes. Will you please tell me how I may overcome this trouble and just how to do it? A We have nothing better to offer for the renewing of dry cells than you already have tried. It is not worth the while to renew these cells The liquid is very slowly absorbed and the cell is already full of crystals from the last charge, which are the result of the action and which will not dissolve in the liquid which you put into the cell For these reasons one does not get much current from a renewed dry cell We publish all such processes for the reason that many amateurs like to experiment with any such process and they get much pleasure out of the work Probably your result was as good as could be expected.

(12149) F M R says Is it ever possible that a stone will never reach the bottom of water in mid ocean which may be, let us say 25 miles deep? That is is water ever so compressed that a stone will displace a volume of water which at this great pressure is equal to the weight of that stone? To state the same question in a different way Would a submarine diver require heavier shoes to go down 100 feet than he would to go down 20 feet? Allowing of course for the added buoyancy of the longer air pipe A Water is one of the most incompressible of materials, far more so than the hardest steel It follows from this that a substance which is denser than water at the surface of the ocean will never become lighter than water as it sinks, or that water will never become as dense as this substance at any depth, since the substance will be compressed more by sinking in the water than the water has been at any level under the water You will find a full discussion of this question in the following numbers of the Scientific American Vol 96, Nos 9 13 and 19, in Answers to Queries We will send the three papers for 10 cents each

(12150) E. D says Would you please tell me what weight of wire should be used on the fields of the simple electric motor described in Experimental Science Vol I page 407 for shunt winding using single cotton covered wire? Please state also the length of wire on each coil of the fields. A We have no additional data for the simple electric motor beyond what is given in Experimental Science or in Supplement No. 641, in which the plans for this motor were originally published. If you connect the motor in shunt it will doubtless run with battery designed for it and described in Supplement No 792 We send all Supplements at 10 cents each. With this battery the current is graduated by varying the immersion of the plates and thus economy of action is secured

(12151) E. H. H. asks how a blue print can be changed to black. A A blue-print can be changed to a black color by placing the print into the following solution Borax ½ ounce, water 8 ounces. When black and wash the print and place it into the following solution Gallic acid ¼ ounce tannic acid ¼ ounce, water 8 ounces As soon as the color is attained wash the print and dry A second blue print can be made from this of course reversed as to position of lines or figures but by placing the back of the changed blue print against the surface of sensitized blue-print paper a duplicate with blue lines can be obtained.

NEW BOOKS, ETC.

FUNDAMENTAL PRINCIPLES OF CHEMISTRY. An Introduction to All Textbooks of Chemistry By Wilhelm Ostwald Translation by Harry W Morse. New York Longmans, Green & Co., 1909 8vo, pp 349

Prof Ostwald's name is one to conjure with in almost every branch of science and in chemistry particularly It would be difficult indeed to mention a chemist who has contributed more to the advancement of his science in our time or one who occupies a more eminent position as a teacher In this book Prof Ostwald has presented with remarkable ingenuity and simplicity the actual fundamental principles of the science of chemistry their meaning and connection and stripped them so far as possible of irrelevant additions. The book may be regarded as an attempt to work out chemistry under the form of a rational scientific system without bringing in the properties of individual substances Hence it has been necessary to restate elementary principles in a new light, and to bring out many new connections in regions hitherto untouched That is why this work will be found different in its treatment from any other work on chemistry that has ever been written The pedagogic value of the preceding can be judged only by the instructor of chemistry But to anyone familiar at all with chemistry, its merit must be apparent from an impartial consideration of the book.

A HAND BOOK OF PRACTICAL CALCULATION AND APPLICATION OF REINFORCED CONCRETE. Kahn System Standards Compiled and published by the Engineering Department of the Trussed Concrete Steel Company 12mo, 126 pp

The rapid growth of reinforced concrete construction makes necessary a hand book on design similar to those in use for the ordinary classes of building material The object of this hand book is to present to the designer tables and information in such form as to be made immediately available for use in actual designs and at the same time to have these tables founded on scientific formulæ approved by our best engineering practice The work as presented deals mainly with the Kahn trussed bar The Kahn system of reinforced concrete however uses in its application several other types of reinforcement including rib metal, hy rib cup bars column hooping, rib lath, and rib studs.

HOW TO OBSERVE AND RECORD THE WEATHER.

(*Continued from page 412*)

mounted very nearly horizontally These two instruments are usually supported as they appear in Fig 3

The minimum is read and then "set' by raising it gently until the index slides to the surface of the alcohol (Fig 5) The maximum must be lowered to a vertical position before it is read (Fig 4) After this reading is taken and recorded the thermometer is then "set' by gently swinging it up and down until that amount of mercury is shaken back into the bulb that represents the difference in temperature between the maximum and the present if any When no more mercury can be returned to the bulb the thermometer is allowed to hang vertically and a second reading is taken The mercury now gives the temperature at the time of reading, and this reading is recorded as 'set maximum' In other words, the maximum thermometer serves in place of two thermometers. First, it records the highest temperatures during the twenty four hours, and secondly, when it is set, it gives the temperature at 7 P M—the time of reading

Exposure—The marked variation between the readings obtained from thermometers owned by private persons and Weather Bureau thermometers is due much more frequently to the difference in the manner of exposing them than to difference in quality accuracy, or cost price Thermometers exposed against buildings, on verandas in windows, cannot often be trusted to give even approximately the true temperature of the atmosphere For the air is not a stationary body but is a continuously intertwisting expanding and contracting gas perpetually seeking an equilibrium which is seldom even momentarily gained than it is instantly lost All gross inaccuracies attending exposure of thermometers are overcome by the shelter adopted by the Weather Bureau and provided to all observers (Fig 9)

The outside dimensions are 42 inches long by 36 inches wide by 30 inches least height, and a second roof 6 inches above, has two ends open. The air has free access to the interior, for the four sides of the shelter are louvered; that is, composed of shutters. These shutters overlap, and have a pitch which enables them to shed water, and intercept also the rays of the sun, even when level at sunrise or sunset.

Shelters ought to be placed in a large open space, or upon a house top or other high building, where the circulation of the air is unimpeded Correct temperatures are recorded only when the air flows freely round the shelter as well as through it When the shelter cannot be situated in an open area, it may be set up on the north side of a building, with a space not less than four inches intervening.

Sunshine does not give the average temperature of the air, but the highest, and so a thermometer, hung in the sun, falsifies or greatly exaggerates. If the temperature is 87, a thermometer in the sun will run up to 100 or more The confiding observer, suddenly aware how hot it apparently is, grows faint from the imaginary heat, runs for a fan, and rapidly raises his bodily temperature by his vigorous gesticulations trying to cool himself.

Instruments that measure the depth of the fall of rain are neither well known by sight, nor is the method by which they record the rainfall very familiar

Fig. 7 shows the essential parts of a rain gage which are a receiver a measuring tube, and an overflow The rain is caught by the receiver, the bottom of which is funnel shaped, and falls into the measuring tube Should the amount that falls be excessive, and more than fill the measuring tube, the excess overflows into the outer cylinder The rain gage is designed to catch the precipitation of rain and to facilitate the reading of the amount by mechanically magnifying the quantity The diameter of a Weather Bureau rain gage receiver at the top is 8 inches, the diameter of the measuring tube is 2 53 inches. In consequence of this difference in area, the water in the measuring tube stands ten times deeper than if spread over the area of the receiver, so that a rainfall of one inch in the receiver stands ten inches in the measuring tube. The scale by which the water is measured is graduated in hundredths of an inch, but that inch on the scale is really ten inches long (Fig 8)

In the normal temperate climate, there are only a few rains in a year when a reading of one inch is observed A fall of rain amounting to two inches is uncommon a precipitation recording three or more inches is the exceptional record of a decade or two Some rains, attended by strong wind vivid lightning and apparently heavy downpouring of sheety rain, give a reading as low as twenty five to sixty or seventy hundredths of an inch, while other rains, not so accompanied by electric phenomena and aerial disturbances, occasionally give a reading of an inch or more. Only an experienced observer is competent to make a fairly close guess of the amount of precipitation, and at best his guess is subject to the errors that so commonly invalidate all suppositions.

Snowfall is caught in the large cylin-

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der by removing the funnel and tube. It is measured by first melting the snow, then pouring the water into the measuring tube, and ascertaining the quantity exactly as for rain. The measuring tube may be filled to the brim with warm water, and this poured on the snow, which will soon melt. The measuring tube is filled once, and then emptied, the remainder of the fluid represents the precipitation from the snowfall A third way of arriving at the snowfall is to cut a section of snow by turning the receiver down over it where the snow is level and not blown away nor drifted by wind. The section is then carefully lifted by a small shovel or paddle board, melted and measured To learn approximately the depth of water in a snowfall one-tenth of the thickness of the layer of snow is taken, ten inches of snow being estimated to contain one inch of water but this gives too little if snow is wet

EXPOSURE OF RAIN GAGE—It will not do to set up a rain gage anywhere and expect to get exact measurements of precipitation for the rainfall varies as much as thirty per cent below the normal according to location owing to the action of wind currents, to the intervention of buildings trees or fences unduly near the gage A roof must be at least sixty feet square, and level ere the wind action on the side walls of a building is eliminated from influencing the rain gage in the center

Wind brakes are desirable around an instrument, the rule being that obstructions must be removed a distance equal to their height For this reason, a fence surrounding a rain gage four feet high and four feet away, will favorably overcome the wind so that on a large open space more water will be caught by the receiver For it is to be understood that the fluctuations of amounts caught between two rain gages near each other is to be ascribed to the wind Consequently, rain gages protected at a suitable distance from the violence of the wind by bushes fences, trees or buildings catch more water than unprotected rain gages. This may be attributed partly to side currents whirling near the ground and partly to the splashing of the drops of rain if they strike the gage through these intertwisting ground currents (Fig 10)

RIVER GAGES—A river gage is a scale by which the height of water in a stream may be measured, and the stage of water, whether low or high, may be observed and recorded The Weather Bureau endeavors to get reliable data of all streams that affect inland navigation It so happens that it is sometimes important to receive reports of the condition of the upper reaches of certain tributaries that are themselves unnavigable but whose flooding may seriously imperil towns below, and materially swell the high water of the navigable rivers into which they empty

A river gage can be a simple contrivance, and answer all practical purposes for creeks and small rivers A graduated board extending below the lowest known level fastened against a bridge abutment is unexcelled if it be convenient to read it at all times The stone facing of an abutment itself may be smoothed and graduated and be made to answer almost as well as an elaborate device (Fig 6)

Strips of brass or of lead securely inset or marks burned in, will do for graduations The "feet" should be plainly numbered lest in reading the gage when the water is very high, a mistake is made Great care must be exercised to graduate the sloping timbers of this style of gage for which nothing less than an engineer's level is sufficiently accurate for governmental requirements. The illustration explains how this may be done with a carpenter's level

The book in which the observations are written is called the "Meteorological Record" The pages of this record are ruled for date, maximum minimum range set maximum, precipitation prevailing direc-

(*Concluded on page 420.*)

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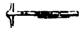

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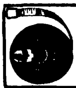

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tion of the wind, character of the day, and remarks.

Opposite the date is set down the reading of the highest and lowest temperatures, the difference is placed in the range column, the set maximum, as explained above, is the temperature at the time of reading. The time of beginning and the time of ending, with the amount of precipitation, is next entered in the record. The prevailing direction of the wind is that direction from which the wind blows the most hours of the twenty-four. The character of the day refers to the sky, whether it is cloudy, partly cloudy or clear. A sky of 70 per cent freedom or more, from clouds is said to be "clear", 50 to 60 per cent without clouds, is called "partly cloudy", none to 20 per cent without clouds is accounted "cloudy". In the column for remarks may be entered notes descriptive of unusual phenomena, such as severe storms, meteors, killing frosts, remarkable depths of snow, floods in the streams of the vicinity, aurora borealis, deaths by lightning. To make the record valuable by the uniformity of its keeping, it is highly important that the readings be taken at the same hour each day, preferably at 7 P. M., seventy fifth meridian time. A column for the water gage may be added, if the levels of a stream are to be observed.

METEOROLOGICAL RECORD,

May 1905 (at Sidney, Ohio)

Date.	Set Max. - P. M.	Maximum.	Minimum.	Range	Precipitation.		Amount.	Wind.	Char. Day	Remarks
					Time Beginning	Time Ending				
1	52	59	35	24				S.	Clear	
2	73	83	46	37	--			S.	Clear	
3	75	88	60	28		-		S.	Clear.	....
4	73	87	62	25	5:40 P. M.	--	0 07	S.	Clear.	....
5					D. N.*	7:25 A. M.	0 18	S. W	Cloudy.	

* During night.

(Copy of Original.)

◆

TESTING THE MAN-ENGINE.

(*Continued from page 418*)

is gaged by another attachment electrically joined to this clock. At the height of the subject's shoulder are arranged, upon a bar, two small hinged uprights. His hand is placed against one of these little posts and he is told to move it as quickly as possible in the direction of the other and to knock both of them down in the least possible time. The clock measures the time interval between the fall of the two uprights, and thus it is possible to time the swiftest movement of the arm in passing through a yard or foot of space. Men are found to be twice as rapid in this movement as women; Indians much slower than whites, negroes more constant than whites in rate of movement.

Another ingenious man-engine gage is a cylinder revolved by clockwork and covered with paper against which rests a marking point moved by air pressure exerted through a tube connecting with any number of attachments. This apparatus is used largely in comparing the workings of the body while under normal conditions and during hard thinking or strong emotion, or after great intellectual or physical effort. Thus when we

(*Continued on page 421.*)

[illegible]	[illegible]
[illegible]	[illegible]
[illegible] C. F. E. Rice	940,714
[illegible]	[illegible]
[illegible] machine, J. Mueller	941,261
[illegible] mould, and other part [illegible] apparatus for producing [illegible] F. E. Thiemeyer	941,211
[illegible] Forrey	941,067
[illegible] Black	941,054
[illegible]	941,019
[illegible]	941,087
[illegible] matic, Duane & Ceeder	940,676
[illegible] for train, J. R. Forsyth	941,096
[illegible] D. Murdock	940,702
[illegible] ple, H. Isaacs	941,074
[illegible] half-tone, J. Harthet, Jr.	940,806
[illegible] ing, G. W Goodridge	941,192
[illegible]	941,224
[illegible] T Bennett	941,290
[illegible] attachment for T J [illegible]	941,296
[illegible] J T Costello	941,069
[illegible] valve, J R Shutt	940,900
[illegible] S. Markstein	941,247
[illegible] J. A. Wise	941 001
[illegible] cutter, G. F Gregory	941,367
[illegible] for machines, Wilcox & [illegible]	940,767
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Power transmitting apparatus, E. A. La [illegible]	941,104
Power transmitting mechanism, C H [illegible]	940 861
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Scientific American Supplements 1568 and 1569 present a helpful account of the making of concrete blocks by Spencer Newberry

Scientific American Supplement 1534 gives a critical review of the engineering value of reinforced concrete

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Scientific American Supplement 1551 contains the principles of reinforced concrete with some practical illustrations by Walter Loring Webb.

Scientific American Supplement 1573 contains an article by Louis H Gibson on the principles of success in concrete block manufacture, illustrated.

Scientific American Supplement 1574 discusses steel for reinforced concrete.

Scientific American Supplements 1575, 1576, and 1577 contain a paper by Philip L. Wormley, Jr on cement mortar and concrete, their preparation and use for farm purposes. The paper exhaustively discusses the making of mortar and concrete, depositing of concrete, facing concrete, wood forms, concrete sidewalks, details of construction of reinforced concrete posts.

Each number of the Supplement costs 10 cents.

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elastic belt placed about the chest is connected with the apparatus, the marking hand will record upon the paper the expansion and contraction due to breathing. Arthur MacDonald, an anthropologist of Washington, has used this instrument in studying the influence of intellectual and emotional states upon breathing and has found that, in general, concentration of thought, as in mathematical calculations or in reading, considerably decreases the breathing. Inasmuch as a falling off of oxygen in the blood results from decrease of respiration he suggests that this may partly explain the proverbial thin blooded condition of deep students Prof Hugo Münsterberg of Harvard, finds with such an apparatus that sudden pleasure makes the respiration weaker and quicker, displeasure, stronger and slower, excitement, stronger and quicker, acquiescence, weaker and slower A similar apparatus when attached to the wrist writes a record of the pulse-beats, showing that pleasure heightens and retards them, displeasure weakens and accelerates them, and that excitement strengthens and quickens them

There is connected to the same recording instrument a device having two rods which press between the lips and transmit a record of their slightest movements to the paper upon the revolving cylinder Similar gages keep score on the movements of the larynx soft palate, and tongue and thus are all of the physical elements of voice measured while various emotions are being experienced

In one of these laboratories, an instrument when attached to the hand, measures its involuntary movements in three directions—forward and backward from right to left, or upward and downward those three elements being recorded upon one revolving cylinder by a separate marking point Experiments with this device indicate that the hand unconsciously follows the direction taken by the mind When the subject commences to obey instructions to concentrate his mind on some object above or below or to his right or left the record paper shows that the hand has been moved in the direction of that object One test used by Prof Münsterberg is to ask the subject to think attentively of a special letter of the alphabet and then spread in a half circle about the instrument cards bearing these letters The average subject's hand will quickly record an impulse toward the letter of which he is thinking though he is unaware of it Thus it will be seen that whither the mind leads the hand will follow unwittingly, and here we have an analysis of gesture and also of the phenomena of "planchette and "ouija board,' as well as of the old time parlor game of "mind reading"—really muscle reading

These man-engine gages are revealing many other hitherto hidden truths concerning the mind's unconscious control of the body's movements and actions and perhaps the prettiest demonstration of this is given by a device consisting of a great tray containing a man lying flat upon his back and balanced upon two knife blades at such a delicacy of poise that the least movement sets the tray to see-sawing The subject is so placed that his center of gravity rests over the blades and so long as he relaxes his mind and holds his breath a spirit level shows that the tray rests in a horizontal plane, but as soon as he commences to breathe it commences to rock itself in cadence with his inspirations and expirations When the subject, in response to a command, commences to solve a problem in mental arithmetic the end of the tray toward his head sinks and that holding his feet rises, all of which indicates that when there is any call for special activity of the brain the blood rushes to that organ, as if to nourish thought. But now if the subject relax his mind as before the tray will again balance horizontally Next a little device which rapidly revolves two mirror-studded panels is placed before his eyes and may so fatigue

(*Continued on page 422.*)

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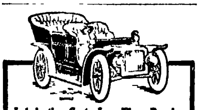

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Inquiry No. 9050.—Wanted, to buy equipment for manufacturing starch and denatured alcohol from potatoes, also manufacturers of equipments for vegetable canneries.

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them that sleep will ensue. If so, the end of the tray holding his head will rise and that holding his feet will fall, showing that in sleep the blood leaves the brain for the extremities. For a somewhat similar purpose is a large glass jar holding the arm, submerged in water. When any action of the mind causes the blood supply of the arm to increase or decrease—as the vital fluid is attracted toward or repelled by the brain—a marking point resting upon the paper of the moving cylinder above described is raised or lowered. With this has been determined that every emotional excitement speaks in the blood supply of every limb.

How our states of mind unconsciously alter, also our powers of performing muscular work, are nicely demonstrated by a machine attached to the middle finger, generally accepted by physiologists as the index to the body's muscular tone. A vise holds the forearm and hand outstretched, palm upward, upon a table, and the finger is harnessed to a cord hanging over a pulley and suspending a weight. As the finger is bent and straightened it raises and lowers the weight and at the same time a recording point worked by the cord keeps score upon a revolving cylinder. It has been discovered that if the subject concentrates his mind upon the effort of thus contracting his finger frequently and each time raises the weight with his utmost force, his finger will weaken and after a time will scarcely stir the weight. But if he continues to make this effort regardless of the results—without worrying about them—sooner or later the strength of the finger will begin to return and will move the weight almost as much as before. Thus he will continue with alternate periods of fatigue and almost complete recovery—a phenomenon akin to that of the athlete's "second wind." The experiment plainly demonstrates how fear of the results of effort will wear upon the muscles with which the effort is made.

Among the most important of the gages which measure a man-engine's comparative powers of self-direction are those which record the acuteness of the senses—of those telegraph systems over which are dispatched, from the various objects to consciousness, the subtle messages upon which our total impressions of perceived objects are based—the raw material, in fact, out of which our every *thought is manufactured.*

Acuteness of hearing is tested by a device in which balls of cork fall a certain distance upon a plate of glass, the ear being distant so many inches. At the outset of this test the height *from* which the balls fall is so slight that the ear does not perceive their impact, but the length of drop is gradually increased until the sound commences to be audible. The acuteness of each ear is measured upon a scale in units of the length of drop at which perception of the sound just barely commences. Then there is a gage measuring the ear's estimate of direction. A graduated horizontal circle surrounds the head and after the subject has been blindfolded a sound is made with a telegraphic sounder moved to the different degrees marked in the circle. The subject's estimates of the direction whence the sound issues are compared with its actual direction.

Acuteness of seeing is measured by devices too numerous for description. One of the most interesting exposes a long black surface across which extend three movable white strips. Two are placed a certain distance apart and the third, moving automatically, is stopped by the subject at the point which he estimates to be exactly between the others. A concealed scale shows his error.

When his acuteness of smell is tested the subject sits before an instrument from which protrude into his nostrils a pair of tubes connecting with a metallic case shielded from his eyes. The examiner *fits to the open end of the* tubes various cylinders filled with substances of different perfume, whose strength varies

(*Concluded on page [illegible]*)

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By A. RUSSELL BOND

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THIS book is a sequel to "The Scientific American Boy," many thousand copies of which have been sold, and has proven very popular with the boys. The main object of the book is to instruct how to build various devices and apparatus, particularly for outdoor use. The construction of the apparatus, which is fully within the scope of the average boy, is fully described and the instructions are interwoven in an interesting story, a feature which has assisted in making the "Scientific American Boy" so popular with the boys.

It takes up the story of "Bill" and several of his companions at boarding school. They form a mysterious Egyptian society, whose object is to emulate the resourcefulness of the ancients. Their Chief Astrologer and Priest of the Sacred Scarabeus is gifted with unusual powers, but his magic is explained so that others can copy it. Under the directions of the Chief Engineer, dams, bridges, and canal-locks are constructed. The Chief Admiral and Naval Constructor builds many types of boats, some of which are entirely new. The Chief Craftsman and the Chief Artist also have their parts in the work done by the Society, over which Pharaoh and his Grand Vizier have charge. Following is a list of the chapters.

Chapter I, Initiation; Chapter II, Building a Dam; Chapter III, The Skiff; Chapter IV, The Lake House; Chapter V, A Midnight Surprise; Chapter VI, The Modern Order of Ancient Engineers; Chapter VII, A "Pedal Paddle-Boat"; Chapter VIII, Surveying; Chapter IX, Sounding the Lake; Chapter X, Signaling Systems; Chapter XI, The Howe Truss Bridge; Chapter XII, The Seismograph; Chapter XIII, The Canal Lock; Chapter XIV, Hunting with a Camera; Chapter XV, The Gliding Machine; Chapter XVI, Camping Ideas; Chapter XVII, The Haunted House; Chapter XVIII, Sun Dials and Clepsydras; Chapter XIX, The Fish Tail Boat; Chapter XX, Kite Photography; Chapter XXI, Water-Kites and Current Sailing; Chapter XXII, The Wooden Canoe; Chapter XXIII, The Bicycle Sled; Chapter XXIV, Magic; Chapter XXV, The Sailboat; Chapter XXVI, Water Sports, and Chapter XXVII, A Geyser Fountain. Index.

Handy Man's Workshop and Laboratory

Compiled and Edited by A. RUSSELL BOND

12mo. 467 Pages. 370 Illustrations.
Price $2.00 postpaid.

EVERY practical mechanic, whether amateur or professional, has been confronted many times with unexpected situations calling for the exercise of considerable ingenuity. The resourceful man who has met an issue of this sort successfully seldom, if ever, is averse to making public his methods of procedure. After all he has little to gain by keeping the matter to himself and, appreciating the advice of other practical men in the same line of work, he is only too glad to contribute his own suggestions to the general fund of information.

About a year ago it was decided to open a department in the Scientific American devoted to the interests of the handy man. There was an almost immediate response. Hundreds of valuable suggestions poured in from every part of this country and from abroad as well. Not only amateur mechanics, but professional men as well were eager to recount their experiences in emergencies and offer useful bits of information, ingenious ideas, wrinkles or "kinks," as they are called. Aside from these, many valuable contributions came from men in other walks of life—resourceful men, who showed their aptness at doing things about the house, in the garden, on the farm. The electrician and the man in the physics and chemical laboratory furnished another tributary to the flood of ideas. Automobiles, motor cycles, motor boats and the like frequently call for a display of ingenuity among a class of men who otherwise would never touch a tool. These also contributed a large share of suggestions that poured in upon us. It was apparent from the outset that the Handy Man's Workshop Department in the Scientific American would be utterly inadequate for so large a volume of material, but rather than reject any really useful ideas for lack of space we have collected the worthier suggestions, which we present in the present volume. They have all been classified and arranged in eight chapters, under the following headings:

I, Fitting up a Workshop; II, Shop Kinks; III, Soldering of Metals; IV, The Handy Man in the Factory; V, The Handy Man's Experimental Laboratory; VI, The Handy Man's Electrical Laboratory; VII, The Handy Man About the House; VIII, The Handy Sportsman; IX, Model Toy Flying Machines. Index.

Concrete Pottery and Garden Furniture

By RALPH C. DAVISON

Assistant Secretary Concrete Association of America

12mo. 196 Pages. 140 Illustrations.
Price $1.50 postpaid.

THIS work should appeal strongly to all those interested in ornamental concrete, as the author has taken up and explained in detail in a most practical manner the various methods of casting concrete in ornamental shapes. The titles of the thirteen chapters which this book contains will give a general idea of the broad character of the work. They are entitled:

I, Making Wire Forms and Frames; II, Covering the Wire Frames and Modeling the Cement Mortar into Form; III, Plaster Molds for Simple Forms; IV, Plaster Molds for Objects Having Curved Outlines; V, Combination of Casting and Modeling—An Egyptian Vase; VI, Glue Molds; VII, Colored Concrete and Methods Used for Producing Designs with Same; VIII, Selection of Aggregates; IX, Wooden Molds—Ornamental Flower Pots Modeled by Hand and Inlaid With Colored Tile; X, Concrete Pedestals; XI, Concrete Benches; XII, Concrete Fences; XIII, Miscellaneous, Including Tools, Waterproofing, and Reinforcing.

The first two chapters explain a most unique and original method of working pottery which has been developed by the author. The chapter on color work alone is worth many times the cost of the book inasmuch as there is little known on this subject, and there is a large and growing demand for this class of work. The author has taken for granted that the reader knows nothing whatever about the material and has explained each progressive step in the various operations throughout in detail. These directions have been supplemented with half-tones and line illustrations which are so clear that no one can misunderstand them. The amateur craftsman who has been working in clay will especially appreciate the adaptability of concrete for pottery work, inasmuch as it is a cold process throughout, thus doing away with the necessity of the [illegible] necessary with the former material. The book is well gotten up, and is printed on heavy glazed paper and [illegible] by handsome illustrations throughout, which clearly show the unlimited possibilities of ornamentation in concrete.

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Telephonic system for auditoriums, K M. Turner	941,114
Thorium sulfid, making, J. L. Huber	941,071
Threshing machine concave, O. H Paschke	941,087
Tie See Cross tie	
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Tire wheel F L. Berg	941 058
Tobacco press, C H Hammond	940 808
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Tool holder, and means for setting the tools therein, M Morton	940 988
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Toy, A. H. Cotton	941,311
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Trap, W W Worcester	940 011
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Truck, car, C. W Wodenski	941,298
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Turbine elastic fluid, P J Hedlund	940 874
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Turbines, automatic stop for elastic fluid F Hodgkinson	940 029
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On December 11th, 1909, the Scientific American will issue a number devoted entirely to the wonderful Middle West region of the United States, a number which will set forth broadly and lucidly not only the agricultural interests of that region, but also those larger engineering undertakings which are destined to transform the Middle West in part at least, into a manufacturing territory

With that object in view the Middle West Number will publish articles on the following subjects

I. The Chicago and Gulf Waterway - An illustrated description of Chicago's drainage canal, an engineering work which stands without a parallel in the world.

II Chicago as a Railroad Center. Chicago is the greatest railroad center in the world.

III. The Wonderful Grain Trade of Chicago. —Chicago is an enormous wheat bin, into which much of the grain raised in the middle West is poured.

IV. Shipping on the Great Lakes.—Most of the iron ore that is now smelted in Pennsylvania is mined in the middle West. To transport it to the blast furnaces of the East at a cost which will enable American steel makers to compete with foreign steel makers, it has been necessary to devise a new kind of lake transportation. Ships of 10,000 and 12,000 tons burden have been constructed which convey ore at small cost through the Great Lakes, and which are without a counterpart anywhere in the world.

V. The Handling and Shipment of Iron Ore.—The above-mentioned fact that iron ore is mined in the middle West and smelted in the East has necessitated not only the construction of special freight-carrying steamers, but also the designing of special machinery for loading and unloading the ore from the steamers.

VI. Freighting on the Mississippi —Freighting on the Mississippi is a more important industry than most of us may realize.

VII. The Steel Industry One of the greatest steel plants in the world is that which has been built at Gary

VIII. The Freight Subway System of Chicago. Chicago can boast of a rational system of handling freight by means of subways.

IX The Water Supply of Chicago. —Chicago's source of water is Lake Michigan. The city is supplied with water by means of a tunnel which extends two miles out into the lake.

X Reclaiming Arid Lands. The United States Government has under way many irrigation projects for the purpose of reclaiming lands which are arid but which will blossom if properly watered

XI Harvesting the Grain of the Middle West Farms that cover not acres but square miles crops that aggregate not simply bushels but car loads, have rendered it necessary to plant and harvest on an unprecedented scale in the middle West. The ingenious agricultural machinery which has been designed to cope with these peculiar conditions is described and illustrated

The Middle West Number will be more than twice the size of the regular SCIENTIFIC AMERICAN It will be lavishly illustrated It will be contained in a colored cover which strikingly depicts Chicago's grain elevators at work. Order from your newsdealer or from

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with the distance to which the cylinders are moved back beyond the tube ends This distance is marked by a scale upon which is read the point where the subject first perceives the perfume, and thus is the acuteness of each nostril determined

Taste is measured by solutions of sugar, quinine, tartaric acid, salt, etc, which are more and more diluted with water until the tongue—to which they are applied with a dropper—no longer perceives the flavors, and the weakness of the solution marks the acuteness of the subject's sense of taste

When testing for acuteness of touch, the examiner holds what appears to be a rimless wheel from whose hub radiate a score of slender spokes From the free end of each hangs a thread of slenderest cocoon fiber suspending a small disk of elder pith All of the disks are of equal size and apparently of equal weight, but in reality are surmounted by tiny buttons of metal which give them different weights, varying from one to twenty milligrammes (1/65 to 20/65 of a grain) The subject being blindfolded, the examiner, commencing with the lightest disk, successively lowers one at a time upon the subject's skin Several of the lighter disks are not felt, but soon there is applied one that is and the weight of this lightest disk perceived determines the subject's sensitiveness. There are additional devices for measuring the various other elements of feeling, such as perceptions of weight, temperature, pressure, pain, etc.

◆

INDOOR BED TENTS.

(Concluded from page 416.)

in the room, and two persons can sleep in the same bed, while only one uses the tent.

This, so far, has been a most successful device for admitting fresh air on sanitary principles to a sleeping room It enables one to breathe the outside air without danger of being chilled or exposed to drafts and colds. Some who tried this tent felt that the fresh air was too cold in storms or wet weather, and they use an outside awning, which can be adjusted at pleasure With these tents the body can be kept warm, while the head, which is toughened to the cold can obtain the stimulation it needs This last can be modified by a Canton flannel hood, which can be made so it will come down over the shoulders, and have a face opening large enough to leave the eyes, mouth, and nose exposed. The cape of this hood covers the shoulders if by any accident the bed clothes slip off them

Fresh air allays sweating, provides good sleep—these tents are capital for insomnia—and helps the appetite The cold air increases resistance to disease purifies the blood and prevents consumption, three reasons why one should breathe it at night The theory of keeping the head in the cold and the body warm is that the body loses eighty to ninety per cent of its heat through the skin by radiation, and cold is bracing only when it comes in contact with the respiratory organs On this theory no good results are obtained when the feet and lower limbs get cold On a cold night one can move away at least twelve inches from the window and still be under the tent, get perfect circulation, and be sure of getting up in a warm room in the morning

Not so many years ago Americans as well as foreigners were afraid of the night air, though we have no such malarial districts as around Rome. Fortunately, we are learning to know better, and workers in Little Italy and the slums where foreigners congregate in cities are pushing the fresh air movement with all their might Fresh air and plenty of it is the best preventive for consumption the grip, bronchitis, common colds and pneumonia. Some sort of inside window tent and paper napkins tissue paper or pieces of gauze which are now used by some people for handkerchiefs are destined to go a long way toward keeping people well warding off disease and the "Great White Plague"

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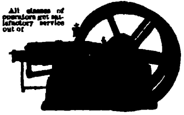

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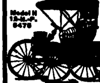

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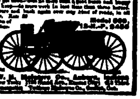

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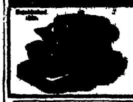

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NEW YORK, SATURDAY, DECEMBER 11th, 1909

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

AGRICULTURE THE BASIS OF PROSPERITY

If any doubt existed that agriculture is the true basis of the prosperity of the United States, it must surely give way before the astounding array of figures presented by the Secretary of Agriculture in his Thirteenth Annual Report, which has reached this office as we go to press with the Middle West Number. Figures of statistics that reach into the billions become, at least to the average mind, merely symbolical; but when the Secretary tells us that for the present year the value of farm products in the United States is $8 760 000 000, and that it represents a gain of $869 000 000 over the year preceding, we can understand why it is that not even our vast manufacturing activity, expressed in great steel mills, machine shops, and factories innumerable, can compare in the value of its output with the products of the farm.

Elsewhere in the present issue we have shown how greatly our industrial prosperity has been due to the invention of labor-saving machinery. Particularly potent has been this influence during the past decade, during which there has been an increasing appreciation of and demand for the latest and most improved appliances. Formerly the scarcity of hired labor discouraged the farmer in the endeavor to get out of his land the full measure of its productive capacity. Thanks to mechanical appliances, the output for a given amount of hired help has been trebled, and in certain classes of work has been multiplied tenfold.

To our excellent State agricultural colleges, furthermore, and the various educational institutions devoted to agriculture, to say nothing of the work of the Bureau of Agriculture, is due much of the credit for the present prosperity. The farmer of to-day is getting a larger return from the land because of his more intimate knowledge of the character of the soil, the nature of the crops for which that soil is adapted, and the proper times, seasons, and methods of plowing, seed time, and harvest.

These influences, coupled with the rapid increase in the acreage of cultivated land, and the breaking up of the old ranges and huge wheat farms into smaller holdings, on which intensive cultivation is carried on, have served during the past eleven years to just about double the annual value of farm products, the increase being from $4 417 000 000 to $8 760 000 000. The total value for these eleven years reaches the enormous sum of seventy billion dollars. Little wonder is it that in some of the great corn and wheat producing States of the Middle West the farmers are enjoying a period of unparalleled prosperity. This princely sum has served to sweep away the farm mortgage—that nightmare of the struggling husbandman of fifteen or twenty years ago. It has established banks, has replaced the tumble-down homestead with modern homes filled with the latest conveniences of civilization; by telegraph, telephone, and railroad it has brought the farmer into intimate touch with the outside world, making him in no mean sense cosmopolitan; and it has served to render doubly secure the traditional right of the farmer to be considered as the backbone of the nation in its larger financial and political interests.

In looking through the details of this report, we find that the corn crop takes the lead in value, with a total of $1 720 000 000, and this, the Secretary tells us, nearly equals the value of the clothing and personal adornments of the 76 000 000 people enumerated by the census of 1900. Equal in value to the gold and silver coin and bullion of the United States, "it has grown up from the soil and out of the air in 120 days—$15 000 000 a day for one crop." Second in value is the cotton crop, the lint and seed of which are worth about $850 000 000 to the farmer. Then follows wheat, whose crop this year is worth about $725 000 000 at the farm. The hay crop represents 665 million dollars, oats, 400 million dollars, potatoes, 212 million dollars, and tobacco, nearly 100 million dollars.

In conclusion, it should be noted that the increase of $869 000,000 in the value of farm products this year over 1908 is sufficient to buy a new equipment of farm machinery for over six million farms, and that the value of the cereal crops of the farmer would pay for all the machinery, tools, and implements of the entire manufacturing industry. Finally, the Secretary tells us that the value of all crops of $5,700 000 000 would make a half payment on the value of all steam railroads according to the valuations of 1904.

The pertinence of these statistics to an issue devoted to the Middle West will be appreciated when it is borne in mind that the Middle or Central West contains more than one-half of the wealth invested in improved farms in the United States, that it has more than one-half of the live stock and neat cattle, that it produces nearly 80 per cent of the food products, and more than one-half of the cereals that are grown in the entire country.

SEA STRENGTH OF PRINCIPAL NAVAL POWERS.

Toward the close of each year our Navy Department, through its Office of Naval Intelligence, issues a comparative table showing the warship tonnage of the principal naval powers. It is based on the number and displacement of warships built and building of 1 000 or more tons, and of torpedo craft of more than 50 tons. The statement for the present year, which shows the relative standing of the navies on November 1st, possesses special interest, because it gives an authoritative statement as to the present strength of the navies in ships of the "Dreadnought" type—a subject regarding which the public has been treated during the past few months to overmuch literature of a sensational and misleading character.

Of battleships of the "Dreadnought" type, Great Britain has afloat and completed four, Germany two, and the United States two. France, Japan, Russia, Italy, and Austria have not as yet completed a ship of the Dreadnought type. Of Dreadnoughts under construction Great Britain possesses seven, Germany six, the United States four, Japan two, Russia four, and Italy one. France and Austria have no Dreadnoughts under construction. In this connection it should be mentioned that our Navy Department does not consider that a battleship is entitled to be reckoned as of the "Dreadnought" type unless her main battery consists entirely of guns 11 inches or more in caliber. This eliminates the six French battleships of the Danton type, carrying four 12s and twelve 9.4s, and the three Austrian battleships of the Ferdinand type, carrying four 12s and eight 9.4s.

Of armored cruisers of the "Invincible" type, Great Britain possesses three and has two under construction, Germany has none completed and three under construction, and Japan has one completed and one building. Adding together the totals for ships armed entirely with big guns, both Dreadnoughts and Invincibles, we find that Great Britain has seven completed, of 125 450 tons displacement, and nine under construction, of 191 000 tons. Germany has two completed, of 36 000 tons, and nine under construction, of 183 000 tons; the United States has two completed, of 32 000 tons, and four under construction, of 83 460 tons. Japan has built one of 14 600 tons, and is building three of 56 200 tons total displacement. Russia has none completed, and is building four of 92,000 tons total displacement. Italy has none completed, and one of 18 600 tons under construction. France and Austria have nothing either afloat or on the stocks of the all-big-gun type.

Of battleships of the first class other than "Dreadnoughts" (in which enumeration the Navy Department includes all battleships of about 10,000 tons displacement or over that are less than twenty years old, unless they have been reconstructed and re-armed since 1900), Great Britain possesses forty-nine, of 714,750 tons displacement, Germany twenty-four, of 282 424 tons, the United States twenty-five, of 334,146 tons, France, seventeen, of 215 270 tons, Japan, twelve, of 171 898 tons, Russia five, of 166,000 tons, Italy ten, of 123 600 tons, and Austria, three, of 31 800 tons. Great Britain, Germany, the United States, and Italy are building no battleships of this class, but France has six, Japan one, Russia four, and Austria three under construction.

Of armored cruisers other than the "Invincible" type, Great Britain possesses thirty-five, of 416,600 tons displacement, Germany, nine, of 86,693 tons, the United States, twelve, of 157 445 tons, France, twenty-one, of 192 982 tons, Japan, eleven, of 130,900 tons, Russia, seven, of 70 200 tons, Italy, eight, of 59 000 tons, and Austria, three, of 18 800 tons.

In the class of torpedo-boat destroyers, Great Britain leads with 148, followed by Russia with 97, Germany with 79, Japan with 56, France with 56, the United States with 17, Italy with 17, and Austria with 6. Great Britain has 20 torpedo boat destroyers under construction, the United States 19, Germany 12, France 16, Japan 3, and Austria 6.

The following table gives the r[illegible] of warship tonnage both at present an[illegible] ships now under construction are co[illegible] will be noted that the only change in rel[illegible] in the second list is that Germany will [illegible] second position at present held by the Unit[illegible].

RELATIVE ORDER OF WARS[illegible]

Nation.	At Present, Tonnage.	With All Vessels Completed, Tonnage.
Great Britain	1,[illegible]350	2,005,873
United States	[illegible]	785,687
Germany	60[illegible]	[illegible]
France	66[illegible]	766,906
Japan	396,[illegible]	488,704
Russia	259,[illegible]	412,[illegible]
Italy	216,0[illegible]	257,818
Austria	114,597	167,[illegible]

Referring to the statistics of total displacement, particularly of battleships of the pre-"Dreadnought" type, we wish to draw attention to the fact that although Germany possesses only one battleship less than the United States, the average displacement of the German ships is very much smaller, being about 11,779 tons as against 13,370 for the United States battleships. Furthermore, our strength in this class of vessel is incomparably stronger, since every one of these twenty-five ships carries a main battery of four guns of 12 or 13-inch caliber, whereas ten of the German battleships carry nothing heavier than a 9.4-inch gun, a weapon which at the great ranges of 7,000 to 9,000 yards at which modern battles will be fought would be altogether ineffective against battleship armor. Hence, as late as a year ago, when Germany had no "Dreadnoughts" afloat, she actually possessed only fourteen battleships capable of fighting effectively at modern ranges, as against twenty-five flying the United States flag, and forty-nine under that of Great Britain.

It is here that the careful observer of naval development must look for an explanation of the feverish haste with which Germany is building a fleet of "Dreadnoughts." The short-sighted policy which led to the mounting of the 9.4-inch gun as the principal arm in her first two squadrons of battleships, left her navy in a very serious condition when the absolute superiority of the 12-inch gun was demonstrated in the battle of the Sea of Japan. Her present lavish expenditure on battleships must be regarded rather in the light of an effort to retrieve a disastrous error than as a distinct challenge to the supremacy of the British or any other navy.

Nor is it any answer to this view of the case to state, as has so often been done of late, that the construction of the first "Dreadnought" robbed all existing battleships of their right to be named as such. We confidently predict that the battleships of the older class will play an unexpectedly important rôle in the next great war; and when two theoretically unsinkable fleets of "Dreadnoughts" have hammered each other into a state of comparative exhaustion, it will be the nation that can send in the most numerous second line of older ships, armed with a mixed battery of 12s and smaller rapid-fire pieces, that will win the day.

THE SECOND REFRIGERATION CONGRESS.

The Second International Congress of Refrigeration will convene in Vienna, Austria, from September 29th to October 3d, 1910. If anything like the interest displayed at the first congress is experienced, the meeting will be a tremendous success.

At the first international congress, which was held in Paris, France, October, 1908, out of a total membership of more than 6,000, about 2 000 were in actual attendance from all parts of the world. About thirty delegates went from America (out of a membership of 401), representing the principal cold-storage houses, manufacturers of ice-making machines, and other allied industries. The first congress was a complete success, and has been the means of arousing the highest interest in the work of refrigeration. Since it was held, national associations of refrigeration have been formed in many different countries, including the United States, Great Britain, Germany, Austria, France, etc., where the preservation of perishable products is being investigated and studied with great care. There is every reason to expect substantial results of a practical character. The second congress, to be held in Vienna in 1910, is being organized very systematically, having the advantage of the experience of the first congress, and it is safe to say that the second congress will make still more valuable additions to our knowledge on the subject involved.

These matters are of the greatest importance to a large and growing industry, particularly in the United States, involving as they do the encouragement of growers and producers of perishable products.

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According to the Geological Survey, the United States leads all other countries in the conversion of raw asbestos into manufactured products, although much less than 1 per cent of the material used is mined in this country.

ENGINEERING.

[illegible] another subway in Brooklyn are being considered by the Public Service Commission If adopted, there will be an extension of the Brooklyn part of the bridge loop through the Eastern Parkway and Brownsville sections.

The efforts of the Chilian engineer, Señor Unduraga, for a canal project which had as its object the construction of a rival system to the Panama Canal, have been abandoned The canal was to extend from the Gulf of Darien along the Altrato River and its branches across Colombia to the Pacific German and British capitalists have expressed their willingness to build a canal which cannot be closed in case of war, the Colombian government, however, would not agree to give a concession, owing to the fear of possible reprisals on the part of the United States.

The new steamers "Olympic" and "Titanic" will be equipped with glass screens on the promenade decks, so that an unobstructed view seaward can be obtained by the passengers in all weathers. Passengers suffer much discomfort by the heavy canvas screens which are strung into place when rain or spray drives on board The new glass screens will not interfere with the view of the boisterous sea, and will also do away with the stuffy feeling engendered by the canvas. The "Rotterdam" is thus equipped, and the novelty has met with much favor The windows are of heavy plate glass, carefully balanced, and slide up or down in the steel fittings which complete the seaward side.

The War Department of the United States has been strongly fortifying the islands at the mouth of Manila Bay On El Fraile Island a fixed battleship of concrete having two steel turrets has been erected, in each of which turrets are mounted two 14 inch guns which can be trained in any direction by the gun crew inside The guns are operated by the general fire-control station on Corregidor Island, where the principal fortifications of the mouth of the bay are located These fortifications are practically complete, and include six 12-inch, one 10-inch, four 6-inch and four 3 inch guns. There are also twelve 12-inch mortars and sufficient equipment for mining the two channels to Manila Bay The artificial ship referred to will be about 100 feet wide and 1,200 feet long

One hundred and fifty locomotives of the Lehigh Valley Railroad are being equipped with a new fuel saving device On all locomotives the air-brake pumps are operated by steam, and it has been the practice to conduct the exhaust steam from the pumps to the smokebox to which the stack is attached and then to release it, causing a draft Considerable work is done by the brake pumps when the locomotive is at a standstill, thus causing a needless loss of fuel By the new arrangement, the exhaust steam is carried outside instead of inside the smokestack. Tests made by the above-named railroad show that the company is saving about 1 000 pounds of coal per locomotive on the descent of the grade from Glen Summit to Penn Haven Junction Penn , a distance of twenty-six miles.

Heavy explosions in the sewers of a portion of New York city containing many garages, states a contemporary, again draw attention to the danger of allowing petrol to enter sewers Some of these explosions were so violent as to resemble the explosion of a small boiler Manhole covers were blown into the air, windows in the neighborhood were shattered, and a number of persons injured. The sewers of the city discharge into tide water, and at high tide the sewage in them backs up in some cases. It is probable that petrol floated on the surface of the sewage when the latter was backed up by high tide, and its vapor was ignited by a spark that might have been due to several causes. While such explosions will not follow every discharge of petrol into sewers, their occasional occurrence and the possibility of much serious injury from them, states our contemporary, are a justification for rigid rules efficiently enforced to prevent the practice

A new device for the prevention of train collisions was recently tested on the Erie tracks between Newark and Nutley, N J The device is an electric one, and is intended to obviate head-on collisions. When the fast-approaching trains equipped with the new device get within half a mile of each other, the air brakes are set automatically, not with the usual suddenness in an emergency, but with a gradually increasing force, the same as a skillful engineer would employ in bringing his train to a halt at a station The trains stopped far enough away from each other to avoid mishap, and all this happened without either engineer moving a hand toward the throttle lever or air brake, the device working automatically. The invention is operated by a third rail, the shoe from the locomotive touching the rail and receiving power through it both for the operation of the emergency brake and also for a telephone. The principle is similar to that of the block-signal system, the track being divided into zones. The brakes can be applied sharply or their operation may be graduated, so that trains may be slowly brought to a standstill.

ELECTRICAL.

Electrical exhibitions seem to be growing in favor with manufacturers, and also receive hearty support from the general public. Only the other day Boston had its first electrical show, and now we learn that San Francisco is to have one from January 29th to February 5th, and Philadelphia during the week beginning February 14th, 1910

A firm in Germany that is building a storage battery locomotive has adopted the Edison storage battery because of its efficiency and lightness. A small locomotive about 25 feet in length has been built It is equipped with two series motors of 35 horse-power each, which are geared to the axles The locomotive weighs 19½ tons, including the battery, which weighs 5 9 tons. At a recent test the locomotive traveled 130 miles on a single charge drawing a car weighing 33 tons.

The city of Ashtabula Ohio, is being fitted with a new telephone equipment which is called 'automanual,' for the reason that it is largely automatic though it requires some manual control The telephone operator is provided with three sets of keys, one of which is operated to connect her receiver with the calling line and as soon as she receives the number she presses keys corresponding to this number and then operates a starting key which automatically connects the calling line with the desired subscriber This done the two circuits are disconnected from all other lines and from the operator so that the conversation cannot be overheard or interrupted by anyone

The German Agricultural Department has been developing the peat lands between Aurich and Wilhelmshaven A canal has been dredged through them, with small branch canals to drain out the bog It was found necessary to operate the machinery used for this purpose with electricity because the vibration of steam engines caused earth slips Accordingly an electric power station was established The quantity of peat obtained from these lands was so large that it was difficult to find a market for it all without doing injury to the smaller peat bog owners Consequently the peat was used in the power station for fuel, and the power output was increased so as to supply distant centers as well as the immediate neighborhood with current

Steam turbines are not the best prime movers for driving propeller shafts, because they are not sufficiently flexible and their greatest efficiency is obtained only when they are operating at speeds that are too high for the propellers For this reason efforts have been made to introduce an efficient transmission gear between the turbine and the propeller shaft At a recent meeting of the Society of Naval Architects and Marine Engineers, held in this city, a paper was read by Mr W L R Emmet on this subject proposing the use of a combination electric drive While the general idea is not new, Mr Emmet presents some novel details Twin screws would be used each driven by an electric motor and a low pressure turbine the motor being energized by a generator connected to a high pressure turbine The low pressure turbine would deliver three-fifths of the power when traveling at full speed, and at low speed would carry no load whatever A proposition has been made to the government to equip one of the new battleships with this system

A number of questions on electrolysis were submitted by the chairman of the Electrolysis Committee in Chicago to the United States Bureau of Manufactures for investigation by American consuls in ten of the largest European cities. The questions were as follows 1 The use of the track rails for the electric return circuit of street railway lines. 2 The permissible drop in potential over the return circuits of street railway lines. 3 The maximum difference in potential between track rails used as return circuits and gas pipes water pipes, or other metallic structures contiguous to the track 4 Regulations or practices with reference to electrically connecting track rails to gas mains, water pipes or other metallic sub-structures. A summary of the answers of the consuls in the cities referred to has just been published in the Daily Consular and Trade Reports In all of the cities rails are used for the return circuit The permissible drop in potential over street railway return circuits in London is 7 volts maximum in Paris 1 volt per kilometer, 5 volts maximum, in Vienna, 5 to 7 volts, St. Petersburg and Moscow 1 5 volts in the city and 3 volts in the suburbs Glasgow and Liverpool, 7 volts, and Christiania 10 volts. The potential difference between track rails and contiguous pipes for London was pipes +1 4 volts and pipes —4 2 volts, Paris, average of 1 volt, Vienna maximum observed 1 volt; Glasgow observed less than 1 volt, Liverpool maximum, 4 5 volts, Christiania maximum, about 5 volts. In London and Glasgow electrical connections between negative returns and contiguous pipes are permitted The cities of Berlin and Brussels make no specific regulations regarding any of the last three questions.

SCIENCE.

Prof. Hergesell of the Strasburg University is bound for St Thomas, West Indies to make atmospheric observations on the Atlantic as part of an international study undertaken by the great meteorological observatories of the world

A German chemist has found 145 grains of free organic bases, estimated as nicotine and 10 grains of combined organic bases, estimated as nicotine, in the smoke from 300 cigars Hence of the entire quantity of organic bases which is contained in tobacco smoke, 94 per cent are present in the free state

French colonial authorities have inaugurated a serious attempt to introduce in the French market the zebu of Madagascar as a substitute for beef The first batch of a dozen carcasses sold in the Paris stalls brought the prices of the highest grades of cattle Herds of zebus otherwise known as Indian oxen which have been threatened with extermination are now being rapidly restored and probably 1 500 000 head roam the plateaus of Madagascar The meat of the zebu is said to be savory and nutritious and is equal to beef

Some fabrics can easily be made waterproof by soaking them in a solution of celluloid in acetone ether amyl acetate, or other volatile solvent The evaporation of the solvent leaves the fabric coated with a thin film of celluloid which is firmly united with the fiber The thickness of the film can be increased by repeating the operation or by using a stronger solution Fabrics thus treated are absolutely waterproof and can be washed without absorbing water Linen which is first starched and then treated by this process can be washed with soap and water without removing the starch

Plans for a national Audubon university on the University Settlement plan, to be endowed with $1 000 000 have been announced in this city Based on the known annual crop loss of $1 000 000 000 due to the spreading pests that the insect-eating birds destroy the calculations of the National Association of Audubon Societies which is back of this project show that the teaching of bird value from such an institution must result in wiping out at least one per cent of the huge national penalty for popular lack of knowledge on this subject For every hundred thousand dollars put into this work of economic education a million is sure to be saved to the agricultural interests of the whole people Successful agriculture means general prosperity and thus every merchant manufacturer and business man of any sort is vitally interested and should bear his part in the plan to educate the public in the great economic *principles of bird conservation*

The manioc root contains from two to three hundredths of one per cent of hydrocyanic or prussic acid which is so poisonous that even this small proportion may produce serious results if it is not thoroughly removed by washing in the preparation of tapioca semolina and other food products which are obtained from the manioc The presence of prussic acid in these products has been detected by analysis The same statement is true of the coarser products employed in brewing distilling, and cattle feeding some of which have been found to contain a quantity of hydrocyanic acid equivalent to a dose of more than half a grain Troy in the daily ration of an animal Thorough cooking volatilizes the hydrocyanic acid already present and destroys the diastases which convert certain saccharine ingredients into cyanogen compounds as has been proved in the case of Javanese and Burmese beans which also contain hydrocyanic acid but manioc products are often fed raw They should always be thoroughly cooked and should be analyzed if the slightest ill effect follows their use

Mr C P Butler, astronomer at the Observatory of Solar Physics has just presented to the Royal Photographic Society of London some very curious photographs of the spectra of Jupiter Saturn Uranus and Neptune taken by the American astronomer Percival Lowell at the Flagstaff Observatory There are in fact in these spectra absorption bands which coincide with the rays of chlorophyl which is as everyone knows the green coloring matter of vegetable cells Thus one would be led to believe from these results that these planets might be covered with some sort of vegetation colored with chlorophyl Remark worthy of attention The lines corresponding with the absorption bands of chlorophyl are more intense as the planet is farther from the sun so that it is on Neptune that plants would be met with in greatest numbers and would be most vividly colored with green But again it would have to be admitted that these planets were all covered with luxuriant vegetation at the moment when the photographs were taken which seems all the more improbable because everything leads us to believe that Jupiter and Saturn are worlds far from being completed However these results are very interesting although contradicting the opinions generally received and they deserve to be noted while awaiting another explanation.

The Reclamation of the Arid Lands of the West.

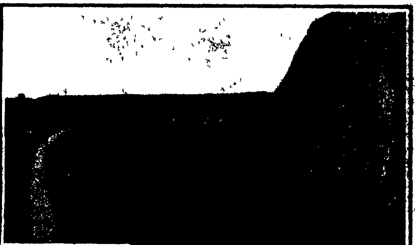
This view shows 22 000 second feet passing through five 8 x 12 foot gates and five large and two small penstock openings in diversion channel

Two of the 8 x 12-foot coffin gates in diversion channel dam

MINIDOKA PROJECT, IDAHO

Height of dam 284 feet. Impounds 1,284,000 acre-feet of water. Will irrigate 210,000 acres. The power house is shown in the foreground.

ROOSEVELT DAM SALT RIVER PROJECT, WYOMING

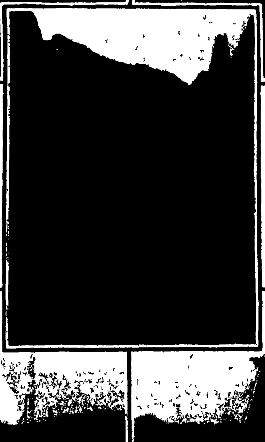


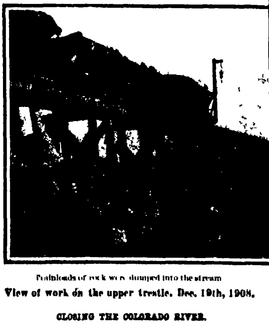
Interstate waterway at Mollies Fork.

NORTH FLATTE PROJECT, NEBRASKA WYOMING

Of all the public works undertaken by the United States government there is probably none that is more popular than the noble scheme for the reclamation of the arid and semi arid lands of the West. The story of the construction of huge artificial reservoirs, far reaching canals and costly tunnels for the storage of the flood waters and their conveyance to barren lands which await only the magic touch of the irrigation ditch to develop their wonderful fertility is one of fascinating interest and the progress of the work has been made thoroughly familiar to the people of the United States by the brush and camera of the artist and the ever ready pen of the descriptive writer.

We must not make the mistake however of supposing that the history of irrigation in [illegible] States dates from the year 1902, when the [illegible] decided to apply its vast resources to the [illegible] its beginning we must go back to the re[illegible] written past, even to the romantic age [illegible] dwellers, for there is clear evidence that in the valleys of New Mexico there once existed a complete system of irrigation canals, that served to render these now desolate districts both fertile and populous. For reasons which we do not know and probably never shall, these ancient and highly developed races degenerated, their homes fell into decay, and their great engineering works became obliterated. Centuries later with the advent of the Spanish settlers irrigation was reintroduced in southern California and in the lower valley of the Rio Grande. The mission fathers also by the aid of small dams and canals, rendered





Trainloads of rock were dumped into the stream.

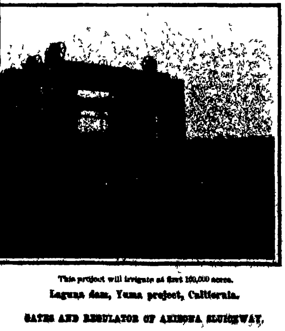
View of work on the upper trestle, Dec. 19th, 1908.

CLOSING THE COLORADO RIVER.

Dam, 310 feet high. Irrigates 100,000 acres.

Shoshone dam looking up canyon.

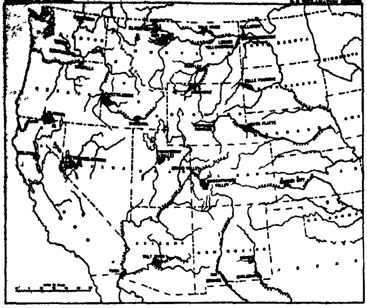
SHOSHONE PROJECT, WYOMING.



This project will irrigate at first 100,000 acres.

Laguna dam, Yuma project, California.

GATES AND REGULATOR OF ARIZONA SLUICEWAY.



MAP SHOWING IN BLACK PRINCIPAL IRRIGATION PROJECTS IN THE WESTERN STATES.

Dam and headworks seven miles from Boise.

PAYETTE-BOISE PROJECT

Concrete flume over main canal.

HUNTLEY PROJECT, MONTANA

fruitful certain local areas in California.

The first successful attempt to apply irrigation to the arid regions is to be credited to the Mormons, who in 1847 made their notable settlement on the barren lands of the great interior basin, on the site where now stands Salt Lake City With the growth of the colony, the work of leading in water from the various outlying streams was extended, and work has been carried on with such good effect that the present extensive system has been pronounced by the Department of Commerce and Labor to be 'the most efficient in the country Many of the pioneers of California turned from mining to irrigated farming, and the work has subsequently been extended to other States, until at the present time over eight million acres of land, which at one time was looked upon as worthless desert, is under cultivation and is producing crops each year whose worth is estimated at over $100,000,000

There are four regions of the United States in which irrigation is practised The arid region, comprising those States and Territories in which agriculture depends almost entirely upon irrigation, the semi arid region, lying midway between the Rocky Mountains and the Mississippi River, where the rainfall is uncertain the rice-producing States, comprising parts of Texas, Louisiana, the Carolinas, and Georgia, and the humid States, represented by several of the New England, Middle Atlantic, and Gulf States, where there is a limited amount of irrigation A Government Report of Irrigation in the United States in 1902 showed that in the arid States and Territories 8 471,641 acres were under irrigation, in the semi-arid States and Territories, 403,449 acres, in the rice States of the South, 606,199 acres, and 5,788 acres in the humid States, making a total for the whole country of 9,487,077 acres. The number of farms included in these systems were 124 036, and the total cost of the work $93 320 152 Practically the whole of this work has been done by private enterprise It includes irrigation of every kind from the ambitious scheme of the large corporation down to the individual irrigation ditch of the small farmer The whole of this work is due to private enterprise unaided by the government

Naturally private enterprise has attacked the problem in those districts where the physical obstructions were the least and in which the water could be impounded or large rivers tapped and the supply brought to the land to be irrigated with the least possible expenditure of time and money There still remained vast areas of arid and semi arid land estimated at some thirty million acres in all, which if the necessary engineering skill and large amount of capital could be found for executing the necessary works, might be rendered fruitful and opened up for settlement

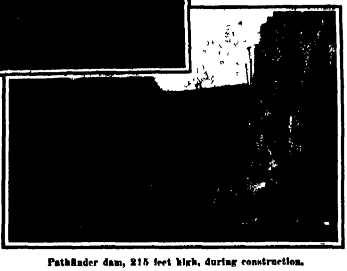
In 1902 the government decided to undertake this great work of reclamation and Congress passed a law providing that the money received from the sale of public lands in the States lying within the arid region be set aside as a reclamation fund to be used in surveys and in the construction and maintenance of irrigation work A law was passed providing that the reclaimed lands were to be sold in tracts of not less than 40 or more than 160 acres Under its terms the settlers are to buy their lands direct from

(*Concluded on page 432*)

Concrete flume which carries interstate canal across Spring Canyon.

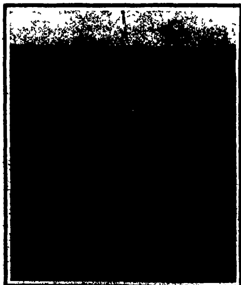
Footbridge across North Platte River, Pathfinder dam.

This project irrigates 110,000 acres.

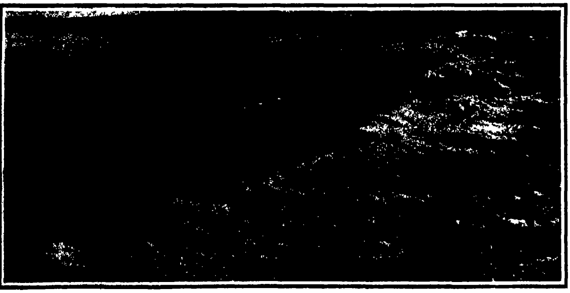


Pathfinder dam, 215 feet high, during construction.

THREE VIEWS OF NORTH PLATTE PROJECT, NEBRASKA WYOMING



The dam and regulating gates.



The spillway at south end of dam.

THE MINIDOKA PROJECT, IDAHO, IRRIGATING 160,000 ACRES BY 1911.

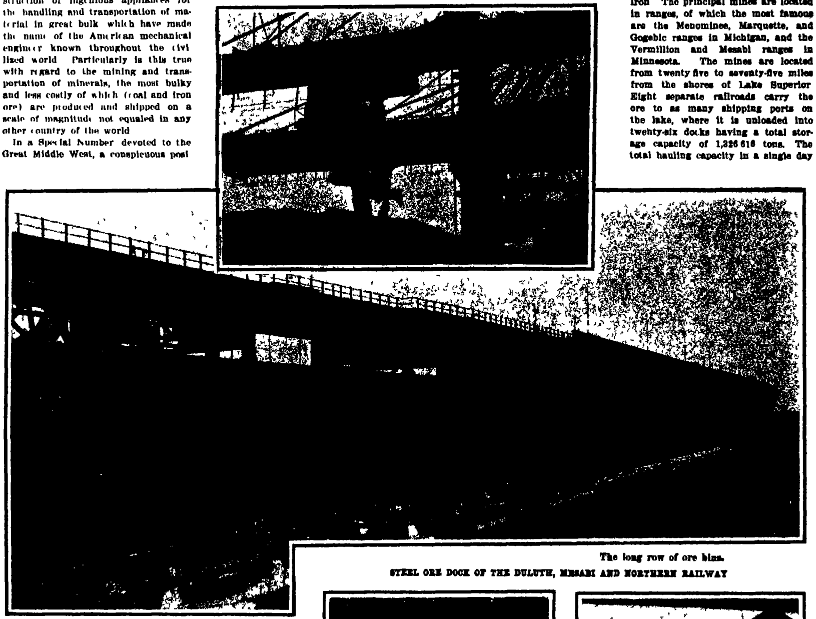
The Wonderful Iron Mines of Lake Superior—How the Ore is Mined and Carried in Bulk.

It usually happens that the attainment by a particular people of great distinction in some special branch of the industrial arts is due to the natural characteristics of the country in which they live. This is certainly true of our own country, whose wide extent and rich natural resources have impelled us to the construction of ingenious appliances for the handling and transportation of material in great bulk which have made the name of the American mechanical engineer known throughout the civilized world. Particularly is this true with regard to the mining and transportation of minerals, the most bulky and less costly of which (coal and iron ore) are produced and shipped on a scale of magnitude not equaled in any other country of the world.

In a Special Number devoted to the Great Middle West, a conspicuous position must necessarily be taken by the steel industry. Elsewhere we have dealt with Gary, where the largest and most up-to-date steel works in the world has lately been put in operation. The present chapter describes the vast deposits of rich iron ore which lie near the shores of Lake Superior, and those methods of mining, transportation, loading and unloading, by which the enormous bulk of ore which is necessary to keep the blast furnaces of our steel works in continuous operation, is brought from mine to furnace at a cost so low as to enable this country to manufacture steel far more cheaply than any other country in the world.

THE LAKE SUPERIOR IRON MINES.—If Nature [illegible] out with the determination to assure for the [illegible] States the premier position in the steel industry of the world, she could scarcely have done so more effectively than by spreading out around the western and southern shores of Lake Superior those huge deposits of iron ore above referred to. Not only do the ore formations cover vast areas, but in the wonderful Mesabi mines the ore lies practically at the surface of the ground, and frequently, after a few feet of overlying material have been stripped off, the cars can be run right into the mine and loaded directly by steam shovels. Furthermore, the Lake Superior ore is of unusual richness, much of it running over sixty per cent iron. The principal mines are located in ranges, of which the most famous are the Menominee, Marquette, and Gogebic ranges in Michigan, and the Vermillion and Mesabi ranges in Minnesota. The mines are located from twenty-five to seventy-five miles from the shores of Lake Superior. Eight separate railroads carry the ore to as many shipping ports on the lake, where it is unloaded into twenty-six docks having a total storage capacity of 1,326 616 tons. The total hauling capacity in a single day

Five-ton buckets unloading material at the stock pile



The long row of ore bins.

STEEL ORE DOCK OF THE DULUTH, MESABI AND NORTHERN RAILWAY

Steel viaduct approach over which trains run to the ore bins

The ore discharges through spouts by gravity into the holds of the steamers.

VIEW OF STEEL ORE DOCK AT DULUTH, MINN., TAKEN FROM DECK OF STEAMER.

The ore is delivered to these bins from the steamer or stock pile.

ORE, LIME, AND COKE BINS AT FEDERAL FURNACE STEEL PLANT.

Shows details of [illegible] hoisting machinery. Length, 354 ft. 8 in.; bucket lifts 7½ tons.

TOP VIEW OF ELEVATED BRIDGE TRAMWAY AT BUFFALO, NEW YORK.

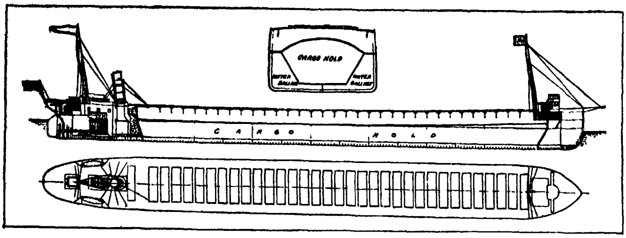
of these eight railroads combined is 250,000 tons. The greatest record for unloading is that of the Duluth, Mesabi & Northern, which in a single day has loaded 165,000 tons into sixteen steamships.

In the course of an interesting and illuminating address dealing with the history of the Lake Superior mines, given last summer by William J Olcott, president of the Oliver Mining Company, Duluth, the speaker drew attention to the fact that in 1844, while William A. Burt was surveying township lines and making geological observations in Marquette County, Michigan, he noticed a deflection of eighty-seven degrees from the normal of the solar compass, and thereupon sought for and found at several points outcrops containing iron ore. In 1847 a forge was started about three miles from these outcrops, and on February 10th, 1848, the first iron to be made in the Lake Superior region was produced by Ariel N Barney, the daily output of the forge being about six tons. The early development of these mines was little more than crude exploration In the winter of 1850, the first ore was hauled to Marquette on the shores of Lake Michigan. In 1852, Congress granted to the State of Michigan 750,000 acres of land for the construction of a small canal around the Rapids of St. Mary's River, connecting Lake Superior and Lake Huron The canal was completed in 1855, and the first shipment of iron ore consisted of 132 tons, which passed through the canal on August 17th of that year In those early days mining was done by open pit work methods the ore being hauled out in carts and dumped into railroad cars The Marquette range furnished all the iron ore from Lake Superior until 1876, when shipments began to be made from Menominee range, from which the total output to date has been 63 641,213 tons In 1885, shipments began to be made from the Gogebic in Michigan and Wisconsin, and from the Vermillion mines in Minnesota. Up to date from Vermillion alone over 28,000,000 tons of high grade ore have been shipped

The most famous of the Lake Superior mines, however are those of the great Mesabi range in Minnesota, which extends for an unbroken distance of eighty miles and includes no less than eighty six mines The geological formation is peculiarly favorable for mining The greater part of the ore bodies lie horizontally and are covered by a shallow bed of glacial drift To get at the ore it is merely necessary to remove the surface covering and then excavate the ore with the steam shovel, loading it directly into the cars trains of which are run into the mines for this purpose Furthermore the ore beds are as rich as they are extensive for analysis shows them to consist of from 47 50 per cent to 61 26 per cent of pure iron, with an average for the whole district of probably about 57 per cent of iron Although the first mine in the Mesabi range was discovered as late as 1890, in the year 1907 over 27 000 000 tons were shipped from this range alone "It is the low cost and capacity for enormous production of the Mesabi range says Mr Olcott that is the guarantee of the continued supremacy of the United States in the manufacture of iron and steel '

We are accustomed to look upon the excavation of

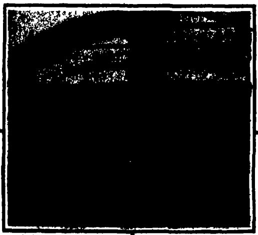
(Continued on page 449)

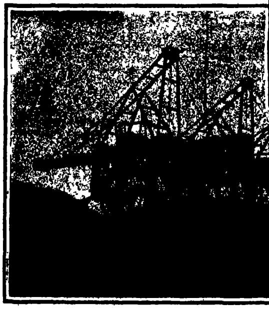


Transverse section, inboard profile, and plan, showing the one great hopper hold 409 feet long with its 33 hatches

THE "WOLVIN," A TYPICAL LAKE STEAMER FOR THE TRANSPORTATION OF ORE CAPACITY 11,686 TONS

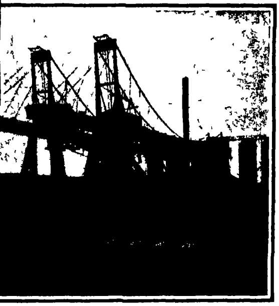
Ten-ton bucket of unloader in hold of the "Wolvin."





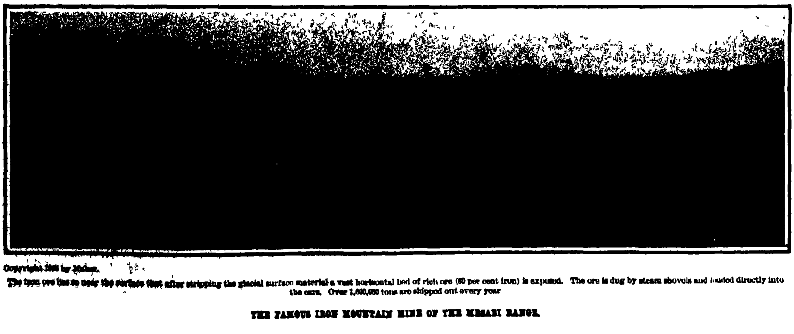
Length of bridge, [illegible] feet 8 inches. Bucket lifts 5 tons.

THREE FAST PLANTS UNLOADING WHALEBACK STEAMER.



Length of tramway 380 feet Bucket capacity 5 tons

TWO BROWN TRAMWAYS UNLOADING A TYPICAL LAKE STEAMER.



Copyright [illegible] by [illegible].

The iron ore lies so near the surface that after stripping the glacial surface material a vast horizontal bed of rich ore (60 per cent iron) is exposed. The ore is dug by steam shovels and hauled directly into the cars. Over 1,000,000 tons are shipped out every year

THE FAMOUS IRON MOUNTAIN MINE OF THE MESABI RANGE.

THE RECLAMATION OF THE ARID LANDS OF THE WEST

(*Concluded from page 429*)

the government, instead of obtaining them by rent or purchase from land and irrigation companies. The price of the land is determined by the cost of the irrigation works for that particular district, and the funds thus obtained are turned into the general Reclamation Fund and used for the construction of work in other districts The settlers pay for the land in installments and payment must be completed by the end of ten years In addition to paying for the land, the farmer is subjected to an annual charge for the water, and the money so received is also applied to the maintenance and improvement of the work It can thus be seen that the fund is made self perpetuating.

The general surveys for this wonderful work have been made, and the scheme includes some twenty-eight different projects,' as they are called, the location of which is indicated on the accompanying map by shaded areas We also present a table, which gives the area in acres and estimated cost of such part of each project as will be completed by the year 1911 They vary in size from the Salt River project in Arizona, which will bring 210 000 acres under cultivation by the year 1911 at a cost of $6,300,000 down to the Garden City stream in Kansas which will irrigate 8,000 acres at a cost of $350 000 By the close of that year, nearly 2 000 000 acres will have been reclaimed, at a cost of $70 000 000 The works are in various stages of progress Some are under survey a few have been only recently commenced, while others are practically completed and are already supplying water to certain sections of the areas served At the present time over 1,000 000 acres are ready for irrigation, and certain areas which a few years ago formed part of a dry and trackless desert, are now supporting about 21 000 people on farms whose fertility is in many cases truly phenomenal A large number of towns have sprung up, and the newly-opened districts are being connected by branch lines with the trunk railroads

The beneficent work of the government does not cease with the turning off the water into the canals In each district it maintains farmers who are experienced in the local conditions, for the purpose of teaching the newcomers how to till their land suitably to the special conditions and requirements of the districts in which they have settled Government demonstration farms have been established upon which the fruits and cereals most adapted to the local conditions are raised

Now it must not for a moment be supposed that the two million acres of land to be brought under irrigation by 1911 represent the whole of the government scheme As a matter of fact, it marks merely the beginning of a vast system which contemplates the recovery of no less than thirty million acres These are large figures, let us translate them into the terms of population and taxable value It is estimated that a fair average value per acre of the irrigated farms, including the value of the land and of the improvements thereon is $150 per acre If this is a conservative estimate it follows that the total value of the reclaimed land when it has been brought under full cultivation will be $4,500 000 000 Not only will this vast property be added to the total taxable value of the farms of the United States but judging from present conditions, it will provide homes for at least fifteen millions of people, one-half of them living on the farms and the other half in towns and cities Several of the latter have already been founded in the areas covered by the completed schemes, and are showing every evidence of healthy life and growth Furthermore the government will possess a valuable asset in the water powers which can be developed by utilizing the great available head of water on many of the projects. By January 1st, 1910, about fifty thousand hydraulic horse-power will be available This belongs to the government, and will be sold to the settlers for power, light, and other purposes at the cost of production. So valuable is this asset alone, that it will make up the entire cost on some of the projects.

TABLE SHOWING THE TWENTY-EIGHT PROJECTS OF THE RECLAMATION SERVICE

The areas and costs are for such portions of the various projects as will be completed by 1911

Location	Project.	Area in Acres	Estimated Cost.
Arizona	Salt River	210 000	$6,300,000
California	Orland	20,000	1 200,000
California Arizona.	Yuma	100,000	4 500,000
Colorado	Uncompahgre	140,000	5 600,000
Colorado	Grand Valley	50,000	2,250,000
Idaho	Minidoka	160,000	4 000,000
Idaho	Payette-Boise	100,000	3,000,000
Kansas.	Garden City	8,000	350,000
Montana	Huntley	30,000	900,000
Montana	Milk River including Saint Mary	30,000	1 200,000
Montana	Sun River	16,000	500,000
Nebraska-Wyoming	North Platte	110,000	3,850,000
Nevada	Truckee Carson.	160,000	4 800,000
New Mexico	Carlsbad	20 000	640,000
New Mexico	Hondo	10,000	370,000
New Mexico	Leasburg	10 000	200,000
New Mexico Texas	Rio Grande	160,000	6,000,000
North Dakota.	Pumping Buford-Trenton Williston	40,000	1 940,000
Montana North Dakota	Lower Yellowstone	65,000	2,700,000
Oregon	Umatilla	18,000	1 100,000
Oregon-California	Klamath	180,000	3,600,000
South Dakota	Belle Fourche	100,000	3,500,000
Utah	Strawberry Valley	30,000	1 500,000
Washington	Okanogan	8,000	500,000
Washington	Sunnyside	40,000	1 400,000
Washington	Tieton	24 000	1,500,000
Washington	Wapato	20,000	600,000
Wyoming	Shoshone.	100,000	4 500,000
		1,910,000	$70,000,000

It is impossible within the limits of the present paper to do more than to give a brief outline of some of the more important of these great works.

YUMA PROJECT CALIFORNIA —This project consists in the diversion of the waters of the Colorado River by means of the Laguna Dam into two canals, one on each side of the river The dam is located about ten miles northeast of Yuma, Arizona. These canals will irrigate all the bottom lands of the Colorado and Gila rivers in Arizona between Laguna Dam and the Mexican boundary, about 84,000 acres in all, and in California they will serve 17,000 acres of bottom lands in the Yuma Indian Reservation This region resembles the fruitful valley of the Nile in its soil, climate, and droughts The dam, which stretches entirely across the river, is remarkable more for its length than for its height. Unlike the huge Roosevelt, Shoshone, and Pathfinder dams, to be described later, it is an overflow weir, its purpose being to back up the waters of the Colorado sufficiently to provide a full supply for the two irrigating canals By the year 1911 it will supply water to 100,000 acres at a cost of $4,500,000

SALT RIVER PROJECT, ARIZONA —Of an entirely different character are the engineering works of the great Salt River project, by which, within two years from now, 210,000 acres will be irrigated at a cost of $6,300,000 This project involves the construction of a storage dam 284 feet in height, at Roosevelt, Arizona, which will impound 1 284,000 acre feet of water—that is to say, sufficient water to cover that number of acres one foot deep The dam is most advantageously located in a deep and narrow canyon, whose bottom and sides are of rock The storage basin of the dam which will have a superficial area of 25 5 square miles, will be large enough to catch and store the waters of the great floods to which the Salt River, in common with most of the rivers of the arid regions, is liable. Because of the remoteness of the work, the construction of the dam has involved heavy incidental engineering expenses It was necessary to cut a costly road over which to carry in the machinery and supplies, and because of the high price demanded in the bids for the supply of cement, the engineers were driven to the expedient of erecting a cement mill and manufacturing the cement on the spot. The water is released from the dam by massive gates. It flows down the canyon to a point forty miles below the dam where it is diverted into two main canals, one on each side of the river A power canal 18 5 miles long, serves to develop electric power by which water will be pumped from underground sources, and increase the irrigable area by 50,000 acres, making 210,000 acres in all that will be brought under irrigation by 1911 at a cost of $6,300,000

SHOSHONE PROJECT, WYOMING —Near the northern boundary of Wyoming, the government is building another remarkable dam which has the distinction of being the loftiest structure of the kind in the world It will rise 310 feet above its foundation, and so narrow is the canyon that the masonry will measure only 175 feet along its crest. Here, as at the Roosevelt Dam, it was necessary to cut a road many miles in length out of the solid rock in order to gain access to the site The dam will create a reservoir with a storage capacity of 456 000 acre-feet, and by 1911 the water will be available on some 100,000 acres of choice land The dam will regulate the flow of the water, and thirty miles below the dam the stream will be turned into a tunnel three and a quarter miles in length which will conduct it by a large canal into the district to be irrigated

NORTH PLATTE PROJECT, NEBRASKA WYOMING —The third of the lofty dams is the structure known as the Pathfinder Dam, so named after the well known explorer, Gen John C Fremont, who nearly lost his life at the site of the dam in trying to row through the canyon Although the structure is about 100 feet less in height than the Pathfinder Dam, the storage basin above it is of such favorable formation that it will impound over 1,000 000 acre-feet, and will be capable of holding in check the greatest of the floods to which the restless North Platte is subject. Below the dam the government has built a great canal, 95 miles in length, which will carry the water to the irrigable lands of Wyoming and Nebraska. The broken character of the ground necessitated the construction of several important concrete viaducts, one of which is shown among our illustrations. Because of the porous nature of the soil the canal for many miles of its length is lined with concrete. By 1911 this system will have brought 110,000 acres under irrigation. When the whole scheme has been developed it will serve some 200,000 acres in Wyoming and an equal amount in Nebraska.

MINIDOKA AND PAYETTE-BOISE PROJECTS, IDAHO.—One of the most important works of the Reclamation Service is that which is being carried out on the Snake River in Idaho. At Minidoka a dam and regulating gate have been built across the river, and 130 miles of canal and 190 miles of ditches will serve to convey the water to 160,000 acres of land. Farther down the river, near the border line between Idaho and Oregon are the Payette-Boise works, which by the end of 1911 will bring 100,000 acres under cultivation. Ultimately, this project will reclaim 372,000 acres of land in the Payette, Boise and Snake rivers in southwestern Idaho.

UNCOMPAHGRE VALLEY PROJECT, COLORADO.—To the public mind the most spectacular of the irrigation works is that known as the Uncompahgre Valley, and this because of the great tunnel through the mountain recently opened by President Taft, which forms the most notable feature of the work. In southwestern Colorado the Uncompahgre and Gunnison rivers flow in approximately parallel courses, 10 miles apart, on either side of a mountain range some two thousand feet in height. The Uncompahgre, which is a comparatively insignificant stream, flows through a valley containing 700,000 acres of rich land, whereas the Gunnison, a much larger river, flows in a deep canyon, where there is practically no land available for cultivation The United States engineers decided to cut a tunnel, 10½ feet by 12 feet in cross-section, for six miles through the mountain The location of the tunnel was fixed at a point where the canyon is over half a mile deep A road sixteen miles long was cut down this gorge, the machinery brought in, power plant established, and a few months ago the tunnel was completed When President Taft opened the works the waters of the Gunnison River began to flow through the mountain and emerged in a valley, where they will render fertile some 140,000 acres of rich soil

In conclusion, we should again impress it upon the mind of the reader that the 2 000 000 acres which will be brought under cultivation by the year 1911, represent only about one-fifteenth part of the fertile land which will ultimately be opened for settlement when the various schemes shown on the accompanying map have been worked out to their full development So judiciously has the matter been handled by the United States Reclamation Service that the work will be self supporting and self perpetuating So successful has that portion of it which is completed proved to be that it is safe to say the work of reclaiming barren lands in the United States will go on until the whole of the arid lands upon which it is possible and profitable to bring the water have been brought under cultivation

Limits of space prevent any extended reference to the nature and quantity of the crops that will be produced on these irrigated lands. In many sections the greater part of the acreage will be devoted to the raising of hay and forage, and particularly of alfalfa, for which there is a great demand as winter feed for cattle. The stock, which during the summer is fed upon the high pasture land, in the winter is driven down to the irrigated valley farms, where it feeds directly from the stack Irrigated land yields about five tons of alfalfa to the acre and its average value is about $5 per ton As many as 300,000 head of sheep have been fed in this way in one winter on irrigated land near Billings, Montana The fertility of the farms is something that must be seen to be appreciated Average land in the East will yield 15 bushels to the acre. On irrigated land in Colorado the yield is 40 bushels. The Eastern farmer may gather in a yea one hundred dollars' worth of apples from an acre, whereas on the irrigated land of the West the value of the crop will reach $450 to the acre, and according to Mr J C Blanchard, statistician of the United States Reclamation Service, apple orchards on irrigated land in the Yakima Valley have yielded from $300 to $1,200 per acre annually, while good orchard land sells at from $300 to $2,000 per acre, when containing full-bearing trees. In this same valley the value of farm products in 1907 reached the magnificent sum of $2,625,000, and 65,000 cattle and 20,000 sheep, of a value of $2,000,000, were ranged and fed.

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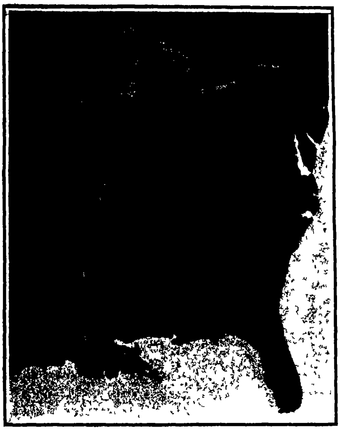
With the purpose of studying enormously high voltages a short experimental transmission line has been built in Sweden which is adapted to operate at 500,000 volts. A special form of transformer is used to furnish this high electro-motive force. Circulating oil is used for insulation between the high and low-tension windings. The line is supported on the suspended type of insulators which are hung at a distance of 11 feet apart. Tests of the surface discharge showed that a wire of 10 square millimeters (0.0155 square inch) cross section would discharge at 35,000 volts, of 20 square millimeters at 50,000 volts, of 100 square millimeters at 200,000 volts, and of 250 square millimeters at 280,000 volts. As the tension was raised to 480,000 volts, the noise grew very loud and sparks leaped from the insulators. At night the glow of the discharge could be seen 3½ miles away.

The Proposed Lakes-to-the-Gulf Deep Waterway.

That portion of the United States which is popularly known as the Middle West, and in the government reports as the North Central Region of the United States, comprises twelve States, whose combined area is 753,550 square miles, and its population approximately thirty millions Within its boundaries are included one-fourth of the area and one-third of the population of the United States

Originally regarded as part of the so-called 'Great American Desert," the Middle West represents to-day more than one-half of the value of the improved farms of the country, contains more than one half of the live stock, produces nearly eighty per cent of the food products and over one-half of the butter, corn, wheat, oats barley rye flaxseed potatoes, and poultry that are raised in the entire United States. Further more as a manufacturing center it contains thirty five per cent of the total number of manufacturing establishments, and turns out annually thirty three per cent of the manufactured products of the country Also from the Middle West comes thirty three per cent of the bituminous coal mined in the United States, and seven tenths of the iron ore

The wealth of a country is very closely related to its facilities for transportation, moreover students of the economics of transportation have come to realize that ideal conditions can be reached only when a country is served by a combined system of railroads and canals or other waterways. Of the former the Middle West possesses a veritable network, being served by over 86 000 miles of track, which represents some forty three per cent of the total mileage of the United States This railroad system has been developed along lines that are admirably adapted to meet the conditions, which are, that a huge and bulky tonnage shall be hauled long distances at a low cost Nowhere in the world is freight moved so cheaply as here But when we speak of the railroad system of the Middle West as being admirable, and while every credit is due for the Herculean efforts which have been made to keep pace with the growth of the country, it must be admitted that this vast network of lines, great as it is, has failed to keep pace with the rapid and enormous increase in the products of the farm and the factory Evidence of this is seen in the steadily recurring periods of congestion, when the railroads are quite unable to move the tonnage that is offered with anything like reasonable expedition


BIRD'S EYE VIEW, SHOWING THE VAST AREA OF COUNTRY TO BE SERVED BY THE GULF TO THE LAKES WATERWAY

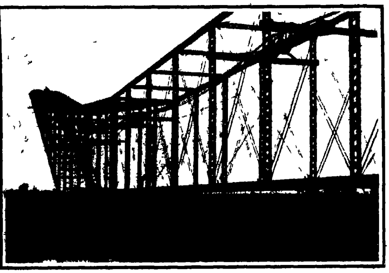
Nature however has provided the Middle West with a system of natural waterways which awaits only the adjusting hand of the engineer to make it capable of transporting at low cost and with reasonable celerity the more bulky freights of the Middle West, leaving the railroads to deal with the higher class freights, for whose more rapid transportation a greater charge is levied and willingly paid We refer of course to the Mississippi River

This noble river which penetrates the Middle West throughout its entire length from north to south has six hundred tributaries forty five of which are navigable and its drainage area is 1 [illegible] square miles Its tributaries reach away east and west from the parent stream for a distance of 4 300 miles If one were to set out in a motor boat with the intention of following every one of these affluents from its point of discharge into the Mississippi up to the head of navigation his upstream journeys would aggregate sixteen thousand miles and cause him to traverse twenty three States and Territories

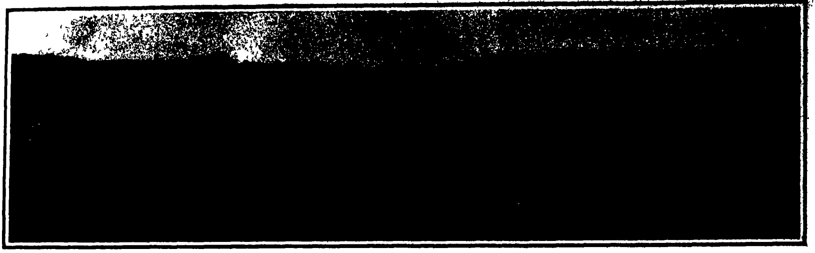
In the early days of the settlement and development of the Mississippi Valley the transportation both of passengers and freight was dependent almost entirely on the river and its tributaries With the advent of the steam railroad and the opening up of what had been known as the Great American Desert lying to the west of the Mississippi and with the construction of a rail road system paralleling the river there was a gradual decline of water borne traffic the passenger travel almost in its entirety and the freight traffic in an ever increasing degree being absorbed by the new and swifter means of transportation

The utility of this great river for the conveyance of freight is greatly curtailed by the fact that it is subject to heavy floods which wash away its banks and deposit the ma

Bear-trap dam downstream view
CONTROLLING WORKS OF DRAINAGE CANAL.


TYPICAL EXCAVATOR AT WORK ON DRAINAGE CANAL.

JUNCTION OF EARTH AND ROCK CUTS ON THE CHICAGO DRAINAGE CANAL.



This great artificial channel, 22 feet deep, 110 to 202 feet wide, and 28 miles long, will form the first section of the Lakes-to-the Gulf waterway

MAIN CHANNEL OF DRAINAGE CANAL, ROMEO CURVE IN DISTANCE

terial in shoals that not only render navigation difficult and hazardous but put a serious limit upon the size and character of the fleet of vessels employed. For many decades past the United States government has maintained a low water depth of between eight and nine feet from St. Louis to the Gulf. This has been done by a system of bank protection dikes and dams assisted by dredging. The depth secured, however, is so limited as to absolutely prevent the development of the traffic to a point commensurate either with the magnitude of the river, or the agricultural and industrial wealth of the vast empire which Nature destined that it should serve.

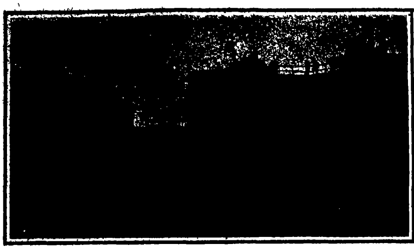
The recent encouraging revival of interest in the development of our waterways has been nowhere more marked than in the Mississippi Valley. Among the various schemes for the improvement of the river the one which overshadows all is the proposal for a deep waterway with a minimum depth of fourteen feet from Lake Michigan at Chicago by way of the Illinois and Mississippi rivers to New Orleans on the Gulf of Mexico. The proposal for a waterway from the Lakes to the Gulf dates from the first settlement of the country, and from that time to this several surveys have been made. As far back as 1848, the State of Illinois built the Illinois and Michigan Canal, which leaves the Chicago River six miles from the lake, and extends to the head of navigation on the Illinois River at Lasalle a distance of nearly one hundred miles. The project included the improvement of the river down to the Mississippi by a system of locks and dams calculated to give a minimum depth from Chicago to St. Louis of seven feet.

LOCK WALL; OVERFLOW FOR 40 AND 18-FOOT DAMS, TAIL RACE AND POWER HOUSE.

The Lakes-to-the-Gulf Waterway.—The present active agitation for the construction of a fourteen foot waterway from the Lakes to the Gulf originated at the time when the State of Illinois authorized the construction of the Chicago Drainage Canal. This great artificial waterway, which, with its connections, is nearly forty miles in length, was constructed for the purpose of preventing contamination of Lake Michigan by the sewage of the city, the whole of which was at that time being discharged into the lake. The distance from the mouth of the Chicago River to its junction with the main drainage canal is six miles, and this portion of the channel is to be widened to two hundred feet with a mid-channel depth of twenty-six feet. The main channel is cut from the river through the divide which separates Lake Michigan from the watershed of the Des Plaines and Illinois rivers. It has a uniform depth throughout of twenty two feet, and it varies in bottom width from 110 feet to 202 feet according to the character of the material, earth or rock, through which it is cut. Its length from the Chicago River to the controlling works at Lockport is 28 05 miles. Subsequently to the completion of the canal, a water-power extension was constructed, which added another 4 30

PANORAMIC VIEW OF A STRETCH OF THE WATER FRONT OF THE MISSISSIPPI AT NEW ORLEANS.

THE PROPOSED LAKES-TO-THE-GULF WATERWAY.



THE LOCK AND ONE END OF THE POWER HOUSE.

HYDRAULIC DREDGE EXCAVATING CHANNEL

miles of waterway, making a total from Lake Michigan of about 38½ miles Into the drainage canal is admitted from Lake Michigan a volume of water whose flow is equal to 10,000 cubic feet per second

At the end of the canal proper are controlling works consisting of gates and a movable bear trap dam, by which the flow of water from the main channel is controlled, and the height of the water regulated There are seven metal sluice-gates of the Stoney type with a vertical travel of 20 feet and an opening 30 feet wide, and the bear-trap dam has a vertical oscillation of 12 feet on an opening of 160 feet South of the controlling works the Des Plaines River (tributary to the Illinois River) has been widened and deepened to accommodate a flow of 1,500 000 cubic feet of water per minute The main channel, the extension to Joliet, etc, involve a total excavation of over 42,000 000 cubic yards of material, and the estimated cost of the completed work is $50,000,000

The legislation authorizing the development of the water power passing through the Chicago canal was secured in 1903, the scheme contemplating the extension of the main channel as a waterway and canal for four miles south from the controlling works. The power house, of which we present an illustration, was located on this extension, two miles below the controlling works, at a point where a drop of 34 feet is available for development. The power-house building, which was constructed wholly of concrete, is 70 feet wide, 47 feet high, and 385 feet long

In 1902 Congress provided for a survey by its engineers to determine the feasibility of building a 14-foot waterway from Lockport to Grafton on the Mississippi, near the mouth of the Illinois River, and in 1905 the Board of Engineers submitted a proposal to canalize the river from Lockport to Utica, a distance of 63.5 miles. The plans provide for locks 80 feet wide, 600 feet long and with 42 feet of water over the sills.

From Utica to Grafton on the Mississippi, 239.5 miles it was proposed to dredge a channel having a bottom width of 200 feet, and depth at low water of 14 feet It is considered that the volume of 10,000 cubic feet, which passes through the Drainage Canal, from Lake Michigan, will supply sufficient water during the summer season to give the required depth of 14 feet from Lockport to the Mississippi River Furthermore it is estimated that the 10,000 cubic feet of water per second will serve for the development of about 135,000 horse-power in that portion of the canal lying between the Drainage Canal and Utica The State of Illinois stands ready to undertake the whole of the work from the end of the Drainage Canal to Grafton, stipulating to turn over the completed navigable channel to the United States on condition that the State retain control of the water power, and that the expense of maintaining the channel be borne by the Federal government.

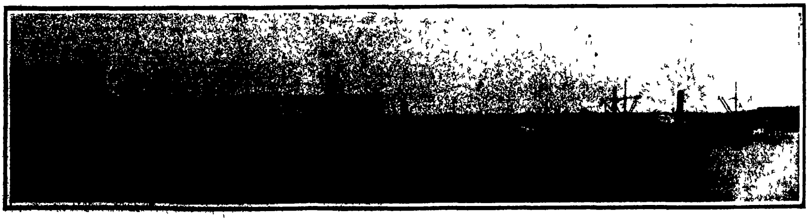
The problem presented by the 38 miles of the Mississippi River from Grafton to St Louis is complicated by the discharge of the Missouri River which acts as a serious disturbing element, and it was proposed to avoid the difficulty by the construction of *an entirely separate waterway along the* easterly bank of the river The plan provides for the construction at Alton of a huge wicket dam 2,[illegible]00 feet long which, by raising the water level 14½ feet, would create a pool that would raise the low water level at Alton about 8 feet and in combination with dredging would enable the full 14 feet of depth to be maintained A canal would be cut from the pool just above the easterly end of the dam and extend parallel with the river to the Merchants Bridge at St Louis a distance of [illegible]8 miles The canal would be maintained at the level of the Grafton to Alton pool and at its southerly end a lock 80 feet wide and 600 feet long with a lift of 30 feet would pass the vessels down from the canal to the deep water at St Louis

ST LOUIS TO CAIRO—The most difficult portion of the whole waterway from the Lakes to the Gulf is the stretch of 180 miles from St Louis to Cairo At low water the river falls on a grade of 0.6 foot per mile producing a rapid current, and there is the added complication that an enormous amount of sediment is brought down from the Missouri River Three methods have been proposed for dealing with this difficult section First, the construction of an independent canal This would be the simplest solution of the problem and the surest but its cost would be altogether prohibitive The second scheme would be to

UPSTREAM FACE BUTTERFLY DAM, CHANNEL EMPTY, DAM CLOSED

CONSTRUCTION OF STONEY GATES AT CONTROLLING WORKS

FORTY-EIGHT-FOOT SECTOR DAM AT POWER HOUSE.



PANORAMIC VIEW OF A STRETCH OF THE WATER FRONT OF THE MISSISSIPPI AT NEW ORLEANS.

THE PROPOSED LAKES-TO-THE-GULF WATERWAY.

canalize the river by building across it at stated intervals submerged dams which would change the total slope of 109 feet into a series of pools, with locks for passing the ships from one to the other This scheme is open to the objection that the enormous amount of silt brought down by the Missouri River, and the material from the constantly eroding banks of the river, would ultimately fill up the pools and necessitate heavy dredging The third method and probably the best would be to maintain the stream at a stated width between banks that were thoroughly protected with revetments

It is not unlikely that the ultimate solution of the problem will consist in a combination of the three methods suggested above It must not be forgotten, moreover that the volume of water available on this stretch during the lowest stages of the river will be increased by the 10,000 cubic feet per second discharged from Lake Michigan through the Drainage Canal Further presumptive evidence of the feasibility of the maintenance of not less than 14 feet throughout the year is to be found in the fact that the improvement work which has been carried on by the government engineers under limited appropriations for a number of years has shown it to be entirely possible to maintain a least depth of 8 feet throughout the period of the lowest stages of water

Cairo to the Gulf of Mexico - South of Cairo, the Mississippi enters the "great alluvial basin" and the question becomes one of keeping the river within its banks and controlling the floods. In this reach of the river the low water flow is 70,000 cubic feet per second which at high water increases to 1 600,000 cubic feet For over half the year except in years of unusually low water a depth of 14 feet is available The 300 miles of the river from Red River to the Gulf provides sufficient depth at all seasons of the year even for ocean-going ships, but from Cairo to the mouth of Red River, a distance of 165 miles there are obstructing bars which would have to be cut through to maintain the 14 foot depth.

For the past six years the engineers have had little difficulty in maintaining a 9-foot channel through these bars by dredging The Mississippi River Commission during 1907 maintained eight dredges at different bars during the low water season, in order to determine the possibility of maintaining a depth of 14 feet, and at three different points it was found possible to develop and maintain depths of 16 feet 17 feet and 16 feet respectively

The Pressing Need for the New Waterway—That the railroads are incapable of handling with facility and dispatch the business of the busy season was recently recognized by James J Hill, when he advocated increasing the trackage by the expenditure of $500 000 000 for new roads The necessities of the West however are so pressing that they cannot await the duplication of railway mileage, moreover the business men of the entire country who are interested in the movement of freight realize that the only permanent and economical solution of the various transportation problems is the improvement of the streams and rivers of the United States A complete system of waterways would act as a regulator of rates and as we have noted above, would serve to relieve the railroads of the more bulky freights which are the cause of the present congestion

That the Lakes-to-the-Gulf Waterway would be a beneficial and profitable enterprise is shown by a comparison of the freight movement by river and by rail from the port of St Louis for the years 1865 to 1900 the statistics of which gathered by J A Ockerson of the Engineers' Club of St Louis were published in the Report of the Mississippi River Commission for the year 1901 They show that the maximum rate on wheat by rail from St Louis to New York was 24 6 cents per bushel in 1877 and 11 6 cents per bushel in 1900 as against 8¼ cents in 1877 and 4¼ cents in 1900 from St Louis to the seaboard at New Orleans Again the total number of bushels of grain exported from St Louis from 1883 to 1900, inclusive was 761, 004 715 The average rate per bushel from St Louis to Liverpool by the Mississippi and Gulf route was 6 85 cents less per bushel than by rail *via* Atlantic ports These figures show that the magnificent sum of over $52 000 000 might have been saved to the producer and shipper had the grain been carried by the river route

The possibilities of river traffic are shown by the two following illustrations The steamer "Sprague" a typical stern wheel towboat of the Mississippi River type, recently took down the river at one haul the cargo of 67,000 tons of coal It would have required nearly 2 000 cars containing the average carload to haul this single cargo Again the 'Harry Frank has carried 9 266 bales of cotton and a quantity of cotton seed at a single load This single cargo would have made 300 train carloads There is a wrong impression in the popular mind as to the relative speed of transportation by water and rail The "Sprague" took down her huge cargo in barges at a speed of from 75 to 100 miles per day, which is much faster than the average speed, as given by a high railway authority, of freight carried by rail.

It is our firm belief that the opening of a waterway 14 feet deep from the Lakes to the Gulf would not only cause an immediate development of the existing traffic, but that a type of steamer suitable for lake and river traffic would be built to meet the special requirements. Furthermore, we believe that the results would be so encouraging as to warrant, before many years had gone by, the expenditure of additional sums of money in increasing the depth of the channel to 20 feet for the accommodation of through shipments in bulk from lake and Mississippi ports to foreign countries.

◆

Halley's Comet,

The total eclipse of the moon on the morning of November 27th was well observed by Prof Brooks at Smith Observatory, Geneva, N Y, the sky being unusually clear after a long period of clouds and storms As a naked-eye spectacle the eclipse was a very beautiful one the moon when immersed in the earth's shadow having the appearance of burnished copper All the different phases took place according to the predicted times as follows

	H	M
Moon entered shadow	2	11 A M
Total phase began	3	14 A M
Middle of eclipse	3	55 A M
Total phase ended	4	36 A. M
Moon left shadow	5	38 A M

The moon was in Taurus, and the occultation of a number of stars by the moon was observed

Several bright meteors from the Biela radiant, and which were due that night, were noted.

Most interesting of all, however was the observation of Halley's comet with the large telescope during the total phase of the eclipse During moonlight the comet was quite invisible even in the largest telescopes, it being yet quite a faint object But during totality the sky was quite black and on setting the telescope to the computed place Prof Brooks had this celebrated comet at once in the field of view Although faint and small, a mere misty spot with a central condensation and diffused edges, it was an easy object in the 10-inch aperture equatorial telescope But in a few weeks it will be considerably nearer the earth, and should be visible in moderate-sized instruments

The position of the comet on the morning of November 27th was right ascension 4 hours 44 minutes 10 seconds, declination north 16 degrees 18 minutes—a short distance south and east of the bright red star Aldebaran in the constellation Taurus

The comet is moving westerly through Taurus at the rate of about one degree daily, but changing very slightly in declination toward the south

◆

A New System of Wireless Telephony

Prof Majorana has made his hydraulic microphone the basis of a new system of wireless telephony The hydraulic microphone consists essentially of a small glass tube, which is attached to a stretched membrane and serves as the outlet of a jet of slightly acidulated water, which is subjected to a certain constant pressure The descending stream passes, at a short distance below the outlet between two platinum electrodes establishing a connection, the resistance of which is modified by the local variations in the diameter of the stream which are produced by the vibrations of the membrane The electrodes and the liquid between them complete the circuit of a Poulsen generator which consists essentially of an electric arc in an atmosphere of hydrogen When words are spoken into the mouthpiece attached to the membrane, the arc emits aerial electric waves, which are in exact accordance with the sound waves striking the membrane, and from which the spoken words can be reconstructed, by suitable devices, at the distant station. Prof Majorana has experimented with a thermo-electric and a rarefied gas receiver, and has transmitted speech to a distance of nearly 200 miles

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A Rule for Stairways.

BY A R. DIXON

In the building of stairways and ladders there is a simple little rule that is of general application and makes the most comfortable and practicable affair to climb It is

2 × the riser + the tread = 24 to 25 inches.

For a ladder this gives a vertical distance between rungs of 1 foot, and the rule is based on the common-sense principle that it is more than twice as hard to lift as it is to go on the level but there is less of it to do

In a power plant the stairs should be straight in order to permit of handling long lengths of pipe, etc. In regard to width, 2 feet 9 inches is about the minimum, but the stairs are sometimes cut a little narrower, where room is available it is better to make the stairs 5 feet wide, which gives plenty of room for two to pass without crowding.—Power

Correspondence.

A TREADLE BOAT.

To the Editor of the SCIENTIFIC AMERICAN

Back in 1856, when I was eight years old, my parents and I had to cross the Hudson River from Hudson to Athens, N Y We crossed in a ferryboat which was propelled by horses which worked a treadle beneath the upper or main deck. These boats were in common use at that time. From this you will see that what may seem curious to the present generation is in reality something that was very common half a century ago.

CHARLES A. HARRIS.

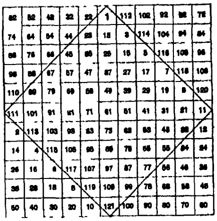
Two Harbors, Minn.

◆

ANOTHER MAGIC SQUARE.

To the Editor of the SCIENTIFIC AMERICAN.

In the October 30th issue of the SCIENTIFIC AMERICAN you publish a certain five square which contains an inscribed diagonal square having all the odd numbers of the square within said inscribed square. Any square based upon a prime number can be arranged so



62	52	42	32	22	1	112	102	92	82	72
74	64	54	44	23	13	3	114	104	94	84
86	76	66	45	35	25	15	5	116	106	96
98	88	67	57	47	37	27	17	7	118	108
110	89	79	69	59	49	39	29	19	9	120
111	101	91	81	71	61	51	41	31	21	11
2	113	103	93	83	73	63	53	43	33	12
14	4	115	105	95	85	75	65	55	34	24
26	16	6	117	107	97	87	77	56	46	36
38	28	18	8	119	109	99	78	68	58	48
50	40	30	20	10	121	100	90	80	70	60

as to conform to the same conditions. Rummaging among a lot of eleven squares made some years ago, I found one having all the odd numbers in same general position but need a little transposition to render the odd numbers regular I inclose you the rearranged square, showing many interesting features besides the massing of the odd numbers

A. GALPIN

Appleton, Wis.

A Metallic Filter.

In all filters of the type of the Chamberland "candle the fine particles suspended in the liquid are retained rather by adhesion to the filtering diaphragm than by inability to pass through the channels which traverse the latter, as the diameters of these channels are much larger than those of the particles and microbes which are arrested The capillary forces are able to exert this filtering action because of the great length and irregularity of the channels of these filters of porcelain or infusorial earth The use of these filters is attended by two inconveniences.

1 After a longer or shorter interval (only 3 or 4 hours in some cases) microbes are found to pass the filter, either because their proper motions are too swift to be stopped by the capillary attraction, or because they multiply in the channels of the filter

2 The long and sinuous channels offer great resistance to the flow of viscous liquids, and this resistance, in contrast to the filtering power, continually increases

Gobbi has devised a metallic filter, the efficiency of which depends upon the narrowness of its channels and which removes microbes permanently, while the molecular adhesion is lessened by straightening the channels and diminishing their length.

The Gobbi filter consists of a strip of nickel 1/250 inch thick, about 1/16 inch wide and several hundred feet long, very finely corrugated transversely and rolled into a coil which can be tightened or loosened by a screw The filtering channels, formed by the opposed corrugations of the successive spires, are straight and only 1/16 inch long (the width of the nickel ribbon) while their diameter can be made less than those of the smallest known microbes by tightening the screw

This filter not only arrests all microbes during a period of several days but retains colloidal particles much smaller than microbes, so that solutions of dyes are completely decolorized by passing through the filter

◆

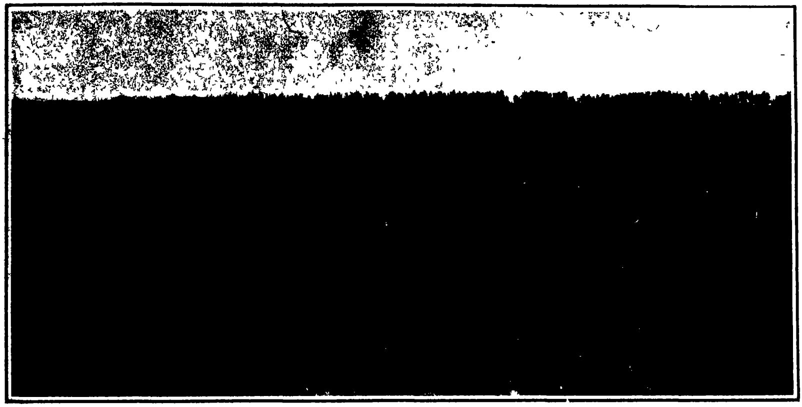
Several American railways are experimenting with mechanical stokers for locomotives. In very few cases have accurate tests been taken, and those that have show results unfavorable to the stoker. Where the firing is well within the capacity of one man without mechanical aid there does not appear to be much reason for installing mechanical stokers, although in America it is hoped that they will help to abate the black smoke nuisance.

American Harvesting Machinery—The Birth and Growth of a Vast Industry.

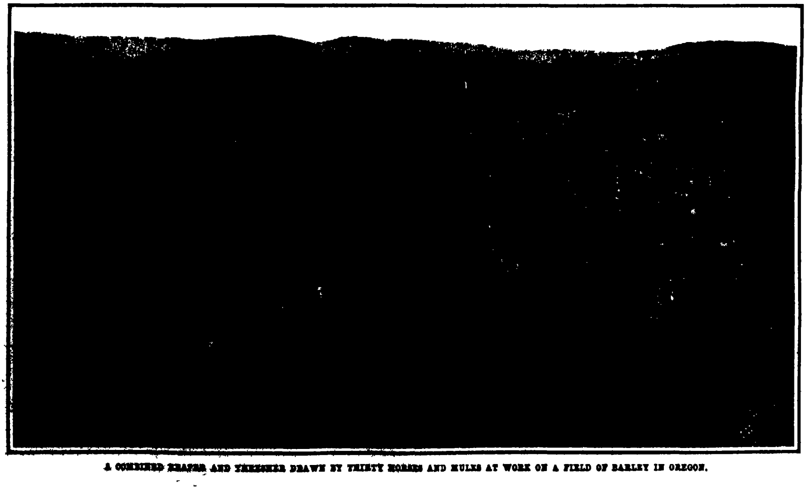
If the political economist is asked to designate the ultimate source of the wealth of the United States, he will point without hesitation to our vast agricultural interests. In colonial days and during the first three-quarters of a century of our life as an independent republic, we were essentially an agricultural people. With the introduction of the steam railroad and the development of our merchant marine, came the development of our manufactures, but these compared with our agricultural interests, were at first insignificant. With the introduction of Bessemer steel, however, we began to make rapid strides in all lines of manufacture, and during the past half century we have moved rapidly forward to the premier position among the great manufacturing countries of the world Nevertheless, it is a fact that to-day, in spite of our leading the world in manufactures it is customary for Wall Street to base its forecasts of the immediate prosperity of the country upon the predictions of the State Agricultural Department as to the prospect of the next year's harvest

This fact of the close relation between the products of our farms and the prosperity of the nation as a whole is pretty well known to every American, but probably few people realize how greatly the development of the farm lands of the United States and the development of their full productive capacity has been due to the invention of special agricultural implements, and particularly of that marvel of ingenuity the American harvesting machine Originally designed to aid the farmer in developing sparsely populated districts in his own country, in which the amount of available manual labor was sadly disproportionate to the vast area brought under cultivation American agricultural machinery has been shipped in enormous quantities to every agricultural country in the world and has been undoubtedly the most potent factor in developing the vast cultivable areas of every continent of the world

For the beginnings of the agricultural implement industry as we know it to-day we must go back to the year 1831 and to the State of Virginia where Cyrus H McCormick built the first practical grain-harvesting machine Compared with the modern harvester it was but a crude affair Nevertheless, it contained the essential elements that have been found in every grain harvester that has proved a success from that day to this The parent machine had a main wheel frame from which projected to one side a platform containing a cutter bar having fingers through which reciprocated a knife which was driven by a crank. Upon the outer end of the platform was a divider which separated the grain to be cut from that to be left standing Above the platform was placed a reel which served to hold the grain against the reciprocating knife and throw the cut grain back upon the platform The machine was drawn by a team which walked by the side of the grain This machine was successfully operated on the farm of John Steel near Steel's tavern in the summer of 1831 The farmers of those days were proverbially conservative and it is amazing to learn that it was not until 1840 that Mr McCormick succeeded in making his first sale It was not until he had gone personally on horse back among the farmers of Indiana, Illinois Ohio and Kentucky and obtained from them written orders for



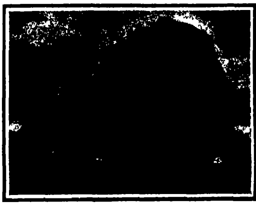
FORTY BINDERS AT WORK IN A WESTERN WHEAT FIELD

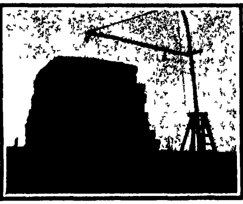


A COMBINED REAPER AND THRESHER DRAWN BY THIRTY HORSES AND MULES AT WORK ON A FIELD OF BARLEY IN OREGON.

his machines, that he induced a firm in Cincinnati to take up their manufacture.

The next step in the development of the reaper of 1851 was the addition of the raker's seat, a device invented by McCormick in 1845, by which the raker could be carried upon the machine and rake the grain from the platform to the ground. In the spring of 1851 McCormick exhibited his reaper at the World's Fair at London, and was awarded the Grand Council Medal. On this occasion the judges referred to the reaper as being worth to the people of England the whole cost of the exposition. At a later exposition McCormick received from the French government the decoration of the Legion of Honor for having done more in the cause of agriculture than any living man.


A 100-TON STACK OF ALFALFA RAISED ON IRRIGATED LAND.

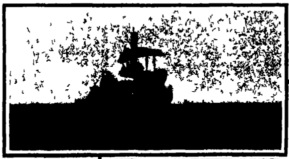

BALED HAY RAISED ON IRRIGATED LAND, TRUCKEE, NEVADA.

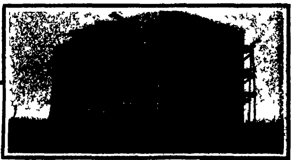
MACHINE LOADING ALFALFA AT LODI, CALIFORNIA.

The next step was taken in 1849, when the Mann brothers of Indiana added a series of endless bands for carrying the grain, after it had been cut and reeled upon these bands, to the side of the machine, from which it was dumped upon the ground. In the same year Jonathan Haines brought out the first "header," which was pushed ahead of the horses, clipping the heads of the wheat which were carried on endless aprons to the side of the machine and deposited in wagons.

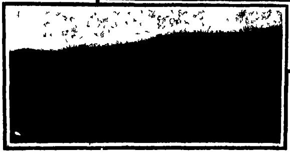
In 1850 Adams and Gifford built the first hand-binding harvesting machine, which contained a platform upon which the grain fell from the endless apron, where it was bound by men carried upon the reaper.

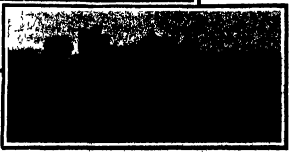
The next stage of development toward the modern self binding harvester was the attachment of a binding device to take the grain that had been cut and raked into gavels, and bind the same automatically into bundles, the patent for this device being taken out by Heath of Ohio in 1850. Then came Jacob Bethel in 1864, who patented the knotting bill which loops and forms the knot, and the turning cord holder for retaining the end of the cord, and later in 1873, after associating himself with A. Wood he built and sold what was probably the first automatic self binding harvester that was ever put upon the market. After various attempts had been made to use wire for binding, Gorham in 1874 put in the field the first successful automatic self-sizing binder. This remarkable machine contained the essential elements of the McCormick reaper with the ingenious grain binder added. The grain is delivered upon a platform, where it is seized by packers, carried forward into a secondary chamber, where it is compacted by the packer against a yielding trip so arranged that when sufficient grain is accumulated the trip yields and starts the binding mechanism into operation. The cord is carried on the machine in a ball. The grain is forced against this cord by the packer, and when the binder starts, the needle encircles the gavel, carrying the cord to a knotting-bill of the Bethel type. Here the end is again seized by the

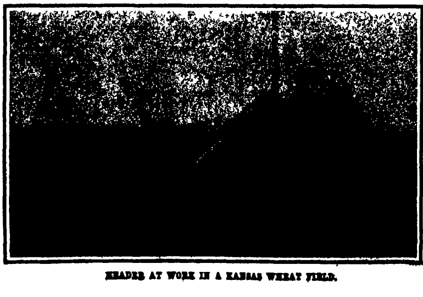

GANG OF PLOWS DRAWN BY A POWERFUL STEAM TRACTION ENGINE. ON THE LARGER FARMS STEAM IS RAPIDLY REPLACING HORSE POWER.

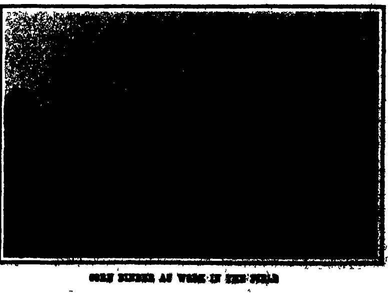

TYPE OF ELEVATOR ERECTED ON IDAHO RANCH FOR INDIVIDUAL USE. FROM THESE ELEVATORS THE GRAIN IS SHIPPED BY RAIL.

TYPICAL OUTFIT ON A LARGE OREGON FARM


THRESHING GRAIN AT CARSON, NEVADA.


BALING HAY AT FALLON, NEVADA.


HEADER AT WORK IN A KANSAS WHEAT FIELD.


CORN BINDER AT WORK IN THE FIELD

rotating holder, the loop formed, the ends of the bands severed, and the bundle is discharged, bound, from the machine. At the same moment a gate, which, during the binding operation, has shut off the flow of grain, retracts, and the operation is again repeated.

This machine cuts the wheat, threshes it, and delivers it ready sacked in one continuous operation.

REAR VIEW OF A 50-HORSE-POWER HARVESTER COMBINE

In the thirty-five years since the production of the first successful self-binder, the progress in the development of the harvester has been in the direction of improving its mechanical details and increasing its size and capacity Originally, the threshing of the grain was done by separate threshing outfits which traveled from farm to farm for this purpose, but with the opening up of the huge wheat ranches of the West, there has been developed and brought to great perfection a combined harvester and threshing machine several illustrations of which are herewith reproduced These wonderful machines cut, thresh, and sack the grain at one operation As they travel through the field, one sees the cutting bar, 15 to 25 feet in length, slicing its way through the standing grain and on the other side he witnesses the steady delivery of the grain in sacks ready to be hauled to the railway elevator The largest of these machines are to be found in operation on the Pacific coast They are either hauled by teams of from thirty to forty horses, or by large steam traction engines The biggest of these, a Best machine, is hauled by a traction engine of 110 horse-power The cutting bar is 25 feet long the separator or thresher measures 54 inches, and has a capacity for cutting and threshing 65 to 100 acres of wheat per day, the amount depending upon the condition of the grain to be harvested The cutting bar of the horse-drawn machine is 16 feet long, and the thresher measures 36 inches. This machine can cut from 35 to 40 acres per day The harvesting expenses when using the steam harvester, are from 35 cents to 60 cents per acre, and the horse-drawn machine operates at an expense of from 50 to 70 cents per acre

There are but few statistics obtainable with relation to the early growth of grass-cutting and grain-reaping machinery In 1840 there were three reapers made, and less than that number of people were employed upon them In 1845, 50 people were employed in the manufacture of 500 machines. In 1850 the production had increased 3,000, and in 1860 20 000 machines were produced, in the manufacture of which 2,000 people were employed About the year 1880 shortly after the automatic cord binder was perfected there was an immediate and marked increase in the output so that by 1885 there were more than 100 000 self binding harvesters built and sold, and 150 000 reapers and mowers 20 000 people being engaged in their production

Although the American harvesting machine has exerted the most potent influence in the development of the arable lands throughout the world there has been a similar advance in the improvement of other agricultural implements and a similar growth in the magnitude of the industry devoted to their manufacture For the following statement of the progress made as shown by a comparison of methods old and new, we are indebted to Mr M. R B Owings, of the International Harvester Company

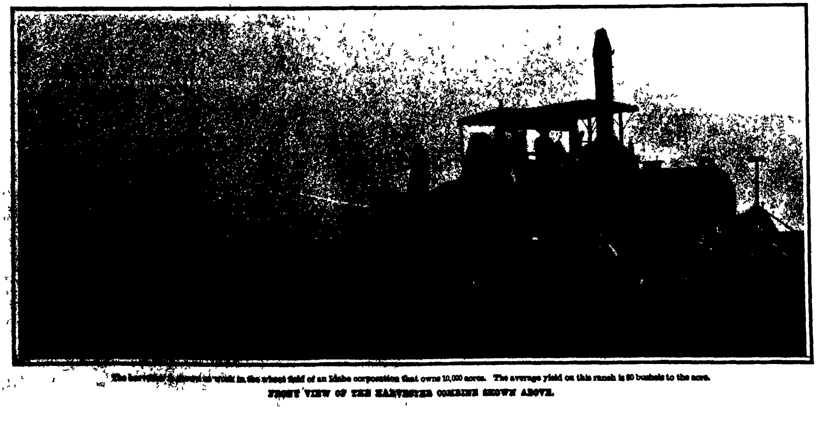
Plowing by Old Methods and New —The old wooden beam walking plow has been superseded by the modern steel beam riding gang plow Throughout the great Northwest, and in nearly all the region west of the Mississippi River, the plow drawn by a traction engine has long since passed the experimental stage Several 16-inch plows are drawn by a 20-horse-power traction engine. On a large farm where three or four such outfits are in operation at the same time it is not difficult to understand how thousands of acres of good wheat land can be plowed, harrowed, and seeded within a comparatively short time, for tractors are also used to operate seeding machines, both the pulverizing and seeding being done in one operation With the old style plow two acres per day could be plowed at the cost of $2 50 per acre With the gang plow drawn by gasoline tractor one and one-fourth acres can be plowed in an hour at the cost of 75 cents an acre If the plows are drawn by a steam tractor, the cost is $2 per acre.

SUMMARY OF THE AGRICULTURAL MACHINERY INDUSTRY 1850-1895

	Census			
	1905*	1890	1870	1850
Number of establishments	648	910	2,076	1 333
Capital	$196,740 700	$145,313,997	$34,834 600	$3,564,202
Salaried officials clerks etc number	7 109	3,717	(4)	(4)
Salaries	$7 572,646	$3,704 66	(4)	(4)
Wage earners average number	47,394	38 827	25,249	7 220
Total wages	$25,002,650	$18,107 094	$12 151 504	$2,167 868
Miscellaneous Expenses	15,1[illegible]8,098	11 159 548	(6)	(6)
Cost of materials used	46,281 306	31 603,265	21 473,925	2,445 65
Value of products.	112,007 344	81 271 651	52 066 875	6,842 611

* Exclusive of the statistics of 98 establishments engaged primarily in the manufacture of other products These establishments made agricultural implements to the value of $1,319 679

Threshing Machines —The threshing outfit commonly used thirty years ago consisted of the old fashioned separator and the now antiquated horse power There were one or two band cutters and one or two feeders according to the width of cylinder were required to feed the grain into the machine three or four men measured and sacked the grain while three



The harvester is shown at work in the wheat field of an Idaho corporation that owns 10,000 acres. The average yield on this ranch is 80 bushels to the acre.

FRONT VIEW OF THE HARVESTER COMBINE SHOWN ABOVE.

to six men were kept busy stacking the straw in a cloud of choking dust.

The modern threshing machine is equipped with an automatic band cutter, self-feeder, automatic weighing and sacking device, and pneumatic swinging straw stacker, the necessary power to operate all of which being either a gasoline or steam traction engine. By the old method of growing wheat, the time required to produce a bushel is three hours. The modern harvesting machines can cut the time down to ten minutes, the old cost being 17¾ cents per bushel, as compared with 3½ cents per bushel now. The old threshing machine had a capacity of 175 to 225 bushels per day; the modern machines can handle 2,000 bushels and over in the same time.

Haying Machines.—A similar advance has been made in machines for handling the hay crop. The old revolving wooden-tooth hay rake has given place to the self-dump sulky steel hay rake. This machine can be operated by a ten-year-old boy, who can do more and better work than could a man using the old method. The hay tedder enables the farmer to cure his hay quickly and greatly improve the quality of the hay. By means of the hay loader, timothy, clover or alfalfa can be taken direct from the swath and loaded on the wagon. With the modern sweep rake the hay can be taken direct from the swath or cock and put into the stack with the hay stacker. Extensive use is also being made of the derrick hay fork, especially when the hay is to be put away in the mow.

Corn Machines.—Thirty years ago much of the corn crop was planted by hand, cultivated with a one-horse walking plow, cut by hand with the corn knife, and put into the shock by main strength and awkwardness. To-day the check rower automatically plants the corn in hills exactly the same distance apart, so that the corn will be in rows no matter in what direction you may look at the field. In other words, the young corn can be cultivated with a riding sulky cultivator both ways, east and west as well as north and south, which of course thoroughly destroys all weeds. When the crop is matured, the modern corn binder cuts and binds the corn into bundles ready to be put in the shock. One man with a corn knife can cut about one acre of corn in a day; the modern corn binder cuts and binds six to ten acres in a day.

The corn husker and shredder has been developed and perfected within the last twenty years. This wonderful machine enables the corn grower to double the value of his corn crop. Heretofore corn has been husked by hand, and the stalks have been allowed to stand in the field and go to waste, for cattle will not eat standing corn stalks. Cutting corn by hand was a slow and laborious task at best, but with the modern corn binder the farmer can cut his corn crop promptly at the time when the nutritious juices are still in the stalk. With the husker and shredder he can husk his corn and shred the stalks, leaves, and husks into stover, which can be put away in the mow the same as hay, or can be baled. Cattle, horses and sheep can be fed on shredded fodder all winter, and they will be kept in good condition without any other feed. In the United States nearly one hundred millions of acres are devoted to growing corn. About two tons of corn stalks are grown on every acre. The modern improvements made in the machines used for handling the corn crop make it possible for the farmer to save two hundred million tons of corn fodder, which, when shredded into stover, is fully equal in feeding value to good timothy hay. At the low estimate of $5 a ton, the husker and shredder alone, if the whole corn crop were shredded, would annually add one billion dollars to the agricultural wealth of the country. The corn sheller enables the farmer to shell his corn quickly if he does not wish to market his crop in the ear.

Cream Separator.—In the old days the milk was strained into crocks and put away in the cellar over night. The cream was skimmed from the crocks and laboriously churned into butter by hand. This old method left the skimmed milk almost valueless—cold, sour, and diluted to such an extent that it had little value for feeding purposes. When the cream separator is used, the skimmed milk is both sweet and warm, and is much relished by calves and pigs. A great deal of work involved in handling the milk is saved by the use of a cream separator. The milk does not have to be carried into the house or to the cellar, or to the spring or cooling tank; there are no unnecessary cans, crocks, pans and other vessels that must be washed. The cream separator enables the farmer to double his dairy products with less than one-third of the work involved in handling the milk the old way. The yearly income from a good cow should be $89.25. Under the old methods the yearly loss was $22, which is altogether eliminated by the use of the cream separator.

Gasoline Engine.—Among the improvements which have helped to transform drudgery to a pleasurable pastime on the farm, the gasoline engine must be given a prominent place. When we were boys on the farm nearly all the odd jobs were done by hand. The wood pile and the corn crib were always full of terrors for the average farm boy, but the gasoline engine has wrought a magical change. This mechanical handy man will furnish power to operate the cream separator, to churn, and to feed the ensilage cutter, and it will saw the wood and shell the corn, and do innumerable other chores that are familiar to everyone who has been brought up on the farm. The gasoline engine is both an economical and reliable power, and it needs but little attention. A 10-horse-power engine of good design uses about one gallon per hour when doing its full 10-horse-power work. The trolley car and the telephone are doing much to bring the farm into closer touch with the larger cities, but it is the gasoline engine that is doing most to keep the boy on the farm. It is made in various styles and sizes, to suit the needs of the ten-acre farm as well as those of the ten-thousand-acre ranch.

Manure Spreader.—A great deal has been written about the abandoned farms of New England, and were it not for the improvements made on the manure spreader now so generally used, the same doleful story would be written about many farms in the Ohio, Mississippi and Missouri valleys. This region has always been known as the garden spot of the world, but even the marvelous fertility that is so common in Illinois, Ohio, Iowa, Missouri and other States, noted for their bounteous crops, would soon become exhausted if the soil were not replenished with plant food. The manure spreader makes it possible for the farmer to renew the fertility of his soil every year. Instead of growing fifteen bushels of wheat to the acre, he fertilizes his ground properly, and reaps a harvest that will average thirty bushels to the acre; indeed many fields have been known to yield as much as fifty bushels per acre.

The modern farmer is working with a well-defined purpose. His constant aim is to do less work that requires muscle and brawn, but more brain work. He purposes to purchase machines that will do the drudgery and irksome tasks, while he himself can find time to solve the problems of farm management. A little head work, properly applied to the management of a farm, will often turn loss into profit.

A Zeppelin Polar Expedition

The object of the Zeppelin Polar Expedition Society, recently organized in Germany, is sufficiently explained by its title. The executive committee has decided to send a preliminary expedition to Spitzbergen, in the summer of 1910, for the purpose of studying the ice of the polar sea and determining the conditions which must be satisfied by a dirigible balloon operating in the polar regions. The committee attaches great importance to new improvements which will enable Zeppelin balloons to make long journeys, and deems it necessary to make preliminary voyages over sea in order to solve numerous problems which are very important to the practice of aeronautics in such conditions. An airship will be at once designed for over-sea flights and should be completed by the beginning of the year 1911.

It might be thought that, as Peary and Cook have reached the pole—and found nothing there, as could have been foreseen—it is useless to send out a polar expedition in an airship, but this view would be erroneous. In previous expeditions the explorers have had neither leisure nor facilities for the collection of important scientific data. If the Zeppelin expedition is successful, its members will be less hampered by lack of time, and less exhausted by fatigue and privation. Hence they may be expected to make scientific observations of great value.

Aging Wines with Ozone.

The quality of wine is greatly improved by natural aging in wood or glass, but this method keeps a large amount of capital unemployed and involves a loss of 4 or 5 per cent by evaporation. The same improvement in the wine can be accomplished more rapidly by the action of oxygen. Boussingault proved that exposure to oxygen makes new wine less acrid and hastens the deposition of impurities in the form of lees. It is asserted, furthermore, that wine does not improve by age, either in wood or in glass, unless it has already absorbed a certain quantity of oxygen from the air, and Pasteur has proved that wine deprived of oxygen is not altered by keeping.

Artificial aging has often been tried, but it has been found impossible to obtain the desired result by the introduction of either pure oxygen or pure ozone. The process patented by Alfred Dorn a few years ago, appears to be more successful. It consists in the introduction of oxygen and its transformation into ozone in the interior of the mass of wine. A tubular electrode connected with an oxygen tank and an induction coil is inserted into the cask, and a portion of the oxygen thus introduced is converted into ozone by the electric current. The operation is continued for a period varying from twenty to ninety minutes, according to the quality and quantity of the wine. For distilled spirits it may be necessary to continue the treatment six hours. This rapid treatment must be followed by natural aging for a short time, but new Bordeaux wine acquires by this method, in from forty to sixty days, the quality of wine kept for many years in bottles.

Rats and Petroleum.

The treatment of stagnant water with petroleum, which is effectual against mosquitoes, operates also in an indirect manner on rats. Mr. Mandoul has made investigations on board "L'Iberethie" during September, 1907. These are abstracted in the Archives de Parasitologie. One of the holds of the ship, which contained silk cocoons, had been almost entirely devastated by rats. Their presence there had probably been due to the saccharine water from the fruits and ice placed near the hold in question. To this body of water, which it had been impossible to remove, petroleum was added. Two weeks later, on arriving at Marseilles, it was found that not one cocoon had been damaged by the rodents. Mr. Mandoul sought to find out how the petroleum had been so efficacious; he endeavored to determine the sensitiveness of the rat to petroleum. A sewer rat was subjected, during about forty-five minutes, to the action of the vapor of about 100 grammes of commercial petroleum in a closed atmosphere (a bell communicating with the exterior by a narrow orifice). The animal began to exhibit labored breathing and, during the last quarter hour, a lassitude in its movements. After these manifestations the animal licked the hairs of its beard; it was depressed and ate little. Three days afterward it was found dead in its cage. The autopsy showed that its viscera were very congested, and that the intestines contained some petroleum. Another rat was subjected to a diet of petroleum. It refused bread treated with petroleum, but accepted meats. It died after about a quarter of an hour. The author made inquiry in petroleum refineries, and upon boats which transport this product. Rats do not exist there or are very rare. Mr. Mandoul concludes that rats have a peculiar aversion for petroleum, which drives them away rather than poisons them, the aversion with which they are inspired resulting from their desire to seek shelter from its toxic action. In addition, the petroleum, thanks to its insecticidal effect, rids the rats of their parasites and of the infectious germs which they are able to transmit.

Chicory Coffee.

At the Congress of the French Association for the Advancement of Science, which was held in Lille, Mr. P. Dorveau gave a communication in which he studied the history of the usage of the roasted root of chicory, as a substitute for coffee—we are inclined to say, as an adulteration of coffee.

The author of this invention is unknown; perhaps he was not willing that future generations should know the name of him who conceived what many consumers cannot fail to call a misdeed; it is true that the growers of chicory, and the manufacturers thereof, have worked hard to erect a statue for him.

Not only is the name of the inventor unknown, but even the date of the invention has been seriously disputed, and is a question which has long been discussed. After examining the documents, Mr. Dorveau believes he has been able to establish that the Dutch used chicory in 1690. There was a delay of almost a century before its usage spread beyond the country of its origin; the Prussians were the first to adopt it in 1763, the French have been making use of it since 1771, and there has been a singular development of the usage of chicory in France since that date.

Valmont d'Bomare, in praising the usage of chicory in his dictionary of natural history, published in 1775, without doubt contributed more than anyone else to its widespread use.

How Long Will the World's Supply of Iron Last?

Less than 2 million tons of iron ore was mined in 1800, less than 11 million tons in 1850, and nearly 85 million tons in 1901. Some day the world's supply of iron will be exhausted, and the question, when this day will come, has already been discussed. According to Prof. Bins, the total quantity of iron ore contained in known and workable deposits amounts to about 8,000 million tons, distributed as follows: Germany, 2,200; Russia, 1,500; France, 1,500; United States, 1,100; Sweden, 1,000; Spain, 500; England, 250 million tons. As an annual production of 50 million tons of iron means an annu[illegible]sumption of from 100 to 150 million tons of ore, [illegible] available supply of iron ore, as estimated above, will be exhausted before the close [illegible] the twentieth century. Apart from the fact that [illegible] regions of the earth have not yet been explored [illegible] search of mineral deposits, this conclusion appears [illegible] too pessimistic for the reason that areas very [illegible] iron, which are not now worked but could be worked [illegible] case of necessity, exist in great abundance. Hence an exact answer to the question appears to be neither necessary nor possible, at present.

Gary: The Largest and Most Modern Steel Works in Existence.

The rapid increase in the business of the United States Steel Corporation rendered it necessary, some four years ago, to make a considerable increase in its plant. The more or less congested conditions surrounding the various existing establishments led the company to search for a site where a large area of land could be purchased at a reasonable price, and which would be located within economical hauling distance of the great centers from which the supplies of ore, coke, and limestone could be derived Such a location was found in the State of Indiana on the south shore of Lake Michigan, some twenty five miles south of the city of Chicago Here the company purchased a tract of over 9,000 acres, with a frontage on Lake Michigan of seven miles. One thousand acres of this property, including a water front two miles in extent, was selected as the site of the new steel plant. The property was a dreary waste of drifted sand, entirely uninhabited and covered with a scanty growth of grass and scrub timber It was an ideal location for the purpose, for on one side it was accessible by the ore-carrying steamers from Duluth and on the other side it was served by several trunk railroads over whose tracks the coke and limestone could be brought in and the finished products hauled away without any intermediate handling or trans-shipment.

With such a virgin site to build upon the designers of the plant were able to work with a free hand, and the component parts of this, the greatest steel plant in existence, were therefore laid out with a strict regard to the economical handling of the enormous masses of raw material and finished product It can be understood that where the total tonnage of material handled in any industrial establishment runs into the millions, it is of the highest importance that this material shall pass from process to process, from building to building, with as little handling and as short a haul as possible, and in laying out the huge open-air structure and inclosed buildings which cover the 1 000 acres that include the present plant, strict attention was paid to this feature. Furthermore, advantage was taken of several recent improvements in the art of steel manufacture, notably that of utilizing the blast furnace gases in gas-driven power plants to operate the blowing engine and provide electrical power for the operation of the various mills. Apart from the vast extent of the plant the feature which has attracted the attention of the engineering world to the Gary steel plant is the great economies which have been effected by the use of gas-driven engines of great size for the generation of practically all of the power required for operating the machinery The plant is owned by the Indiana Steel Company, to whose vice-president Mr G G Thorp, we are indebted for assistance in the preparation of the present article

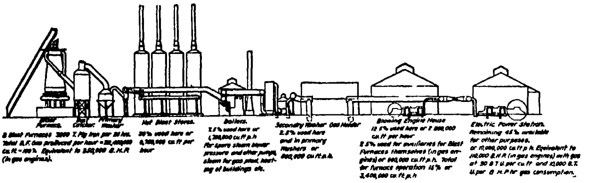

Blast Furnace.
Dust Catcher.
Primary Washer
8 Blast Furnaces 3600 T. Pig Iron per 24 hrs. Total B.F. Gas produced per hour = 22,450,000 cu. ft. = 100%. Equivalent to 202,000 B.H.P (in gas engines).
Hot Blast Stoves.
30% used here or 6,700,000 cu. ft. per hour
Boilers.
7.5% used here or 1,700,000 cu. ft. p.h. For spare steam blower pressure and other pumps, steam for gas plant, heating of buildings etc.
Secondary Washer
Gas Holder
2.5% used here and in primary Washers or 560,000 cu. ft. p.h.
Blowing Engine House
12.5% used here or 2,800,000 cu. ft. per hour
2.5% used for auxiliaries for Blast Furnaces themselves (in gas engines) or 560,000 cu. ft. p.h. Total for furnace operation 15% or 3,400,000 cu. ft. p.h
Electric Power Station.
Remaining 45% available for other purposes, or 10,000,000 cu. ft. p. h. Equivalent to 110,000 B.H.P (in gas engines) with gas at 90 B.T.U. per cu. ft. and 10,000 B.T.U. per B.H.P hr gas consumption.

DIAGRAM SHOWING THE DISTRIBUTION OF THE FURNACE GASES AT GARY

Work was commenced in March, 1906 and at the present time over one-half of the plant has been completed and is in operation The work of construction is being steadily prosecuted and when the whole work is finished the equipment will be as follows

A harbor, with complete ore-unloading facilities, and a storage yard capable of accommodating 5,000,000 tons of ore

Sixteen modern blast furnaces, having an annual capacity of 2,400 000 tons of pig iron

Six open-hearth furnace buildings, each containing fourteen 60-ton furnaces. The combined annual capacity of this plant is 3,750,000 tons

A billet mill and a rail mill the largest in the world, capable of turning out 4,000 tons of rails per day, plate mills, an axle-making plant, and a large group of merchant mills, the above plants having a combined capacity sufficient to roll all of the steel that can be produced in the open hearth furnace plants.

A blowing plant of a total capacity of 92,000 horse-power for furnishing air to the blast furnaces, operated by gas engines of 64,000, and steam engines of 28,000 horse-power total capacity

An electric power plant, driven by gas engines of a combined capacity of 120,000 horse-power, for operating the various mills

A complete equipment of mechanical shops at which all of the repairs can be made and much of the machinery required by the plant.

A water supply system, served by two 10-foot conduits leading from Lake Michigan, whose pumps are capable of supplying 170,000 gallons of water per day under a head of 120 feet.

A railway system extending throughout the plant which includes 125 miles of standard railway track.

TOWN OF GARY

Adjoining the steel plant the company has built an entirely new town for the accommodation of its employees Already it houses some 15,000 people, of whom about one-third are employed at the works and includes about 500 dwellings, three hotels and a school house built by the company Also many dwellings and business blocks have been erected by private persons The town has been laid out on the most approved modern lines with broad brick paved concrete or macadam streets and cement sidewalks It contains its own waterworks and gas plant and the whole town is lighted from a large generating station in the steel plant Space has been reserved for two recreation parks and everything is being done to render this city comparable with the best model industrial cities of the country

THE ORE DOCK AND UNLOADING APPLIANCES

When the ore steamers from Duluth arrive at Gary, they enter an artificial canal 22 feet deep and 250 feet wide, which extends at right angles with the shore line for a distance of 4,650 feet inland when it widens out into a 750 foot diameter turning basin The west bank of the canal adjoining the steel works is formed by a massive concrete retaining wall back of which extending parallel with the canal, are the ore unloaders the ore handling bridges and a vast open concreted area with concrete walls on either side for the storage of the ore for winter use The completed plant will include ton unloading machines of the Hulett type Each machine consists of a massive walking beam at the outer end of which is a vertical arm ending in a 10-ton grab bucket The steamer is moored alongside the concrete bulkhead, and as soon as the hatches are off the unloaders thrust their 10-ton buckets into the holds, bring up the ore and deliver it to a conveyer car which runs back and discharges it into a trough on the edge of the stockyard, or into a hopper on the machine from which it can be shot into cars The machines will have a combined unloading capacity of 2 500 tons of ore per hour Working in conjunction with the Hulett unloaders will be ten Hoover & Mason traveling conveyer bridges These huge structures five of which are shown in our panoramic view of the steel works are about 500 feet long They extend from the concrete trough before mentioned into which the Hulett unloaders discharge clear across the whole width of the stockyard Each bridge is provided with a 15 ton grab bucket by which the ore is picked up from the trough and deposited in the stock pile from which it is picked up again as it is needed and loaded into the blast furnace supply cars The object of the huge storage yard which is 4 000 feet in length is to enable the company to provide a sufficient supply of ore to operate the plant during the five months of the year when lake navigation is suspended Its total capacity is about 5 000,000 tons

THE BLAST FURNACES

Back of the stockyard and extending parallel with the same are eight blast furnaces (to which eight more will be added), each with its equipment of four hot blast stoves The blast furnaces are 88 feet in height from the tap hole from which the hot metal is drawn to the top of the furnace lining, and the capacity of each is 450 tons per day

Between the stock pile and the furnace is a long line of elevated storage bins arranged in two parallel rows. One row is for coke and the other for ore and limestone. Above the bins are four tracks on which travel two 60-ton electric transfer cars. The ore is loaded into the transfer cars by the buckets of the overhead ore bridges. The coke and limestone are brought up over the bins by rail and deliver their load directly by gravity At the bottom of the bins are spouts controlled by electrically operated gates and below these are tracks which run the full length of the bins Traveling on these tracks are electrically operated lorries into which the ore, coke and limestone are delivered from the bin spouts. The lorries carry the materials to what are known as the "furnace skips," of which there is a pair to each furnace The skips run upon an inclined railway which runs direct from a pit below the transfer cars to the charging platform at the top of the blast furnaces Each trip of the skip is made in about 60 seconds and its average load consists of about 7 000 pounds of ore or 6 000 pounds of limestone, or 3 600 pounds of coke The operator merely starts the skip on its journey Its journey up the incline and the halt at the charging platform above are purely automatic

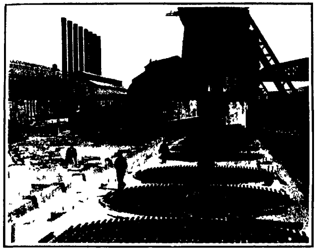
The blast furnace is a huge steel shell lined with a thick wall of firebrick Its interior diameter is 15 feet at the base or hearth 21½ feet at a height of 13 to 21 feet above the hearth 16 feet at the top It is loaded full with a charge of coke limestone and iron ore The air for combustion is introduced through a series of water cooled tuyeres which enter the furnace near the top of the hearth This air is supplied by huge blowing engines at an average pressure of 18 pounds per square inch Part of the hot gases from the top of the furnace after first having been cleaned in the primary washers are led through the hot stoves of which there are four to each furnace as shown in our panoramic view of the plant The stoves are huge cylindrical plate steel structures filled with a honeycomb of firebrick The burning of the gases in the stove raises the temperature of the firebrick and when this has reached a certain point the gases are cut off from that stove and turned into another one of the series. At the same time the cold air from the blowing engines is caused to pass through the now heated firebrick of the first stove where it takes up the heat given up by the combustion of the furnace gases and returns it to the blast furnace The operation of the blast furnace is continuous and the temperature varies from that of the molten iron in the hearth at the bottom to that of the cold charge which has just been introduced at the top As the charge is reduced it gradually descends as molten metal and as slag the slag because of its lighter weight, floating on the top of the molten metal At regular intervals the slag and the metal are separately drawn off into ladles the slag being hauled to the slag pile and the metal being taken to the mixers or cast into pig metal as hereafter described Each furnace at Gary has a capacity of 450 tons per day

CLEANING AND DISTRIBUTION OF BLAST FURNACE GASES

The most striking novelty in the Gary steel plant is the substitution of gas engines for steam engines in producing the enormous quantity of power necessary for operating this huge establishment The blowing engines which supply air for the blast furnaces are operated in part by gas engines of a total of 64 000 horse power and all of the mills are driven by electric motors current for which is produced by electric generators driven by gas engines of the largest size and of a combined capacity of 120 000 horse-power

Originally in the early days of steel making the gases were allowed to escape from the top of the blast furnace and go to waste Then the tops of the furnaces were closed and the gases were conducted to large boiler houses where they were used to raise steam for driving the steam blowing engines throughout the plant In the latest improvements as installed at Gary the whole of the gases are utilized The diagram shown herewith gives the distribution of these gases, and it should be remembered that the figures given are for eight furnaces only which together produce 22 450 000 cubic feet of gas per hour When the whole sixteen are running the total production will be about 45 000 000 cubic feet per hour Of this amount 30 per cent is used in heating the hot stoves in which as we have seen the air is heated before entering the blast furnaces The steam boiler plant uses 7 5 per cent 2½ per cent disappears in the gas washers the blowing engines 12½ per cent and 45 per cent is available for the gas engines in the electric power station All the gas from the top of the blast furnaces first passes through dust catchers and a primary washer which remove the larger part of the solid impurities and that part of the gas which is burned in the hot blast stoves and under the boilers goes direct from the primary washer to its destination The gas which is destined for the gas engines passes through another washing plant of which there are four to each pair of blast furnaces The gas is thus

(Continued on page 450)

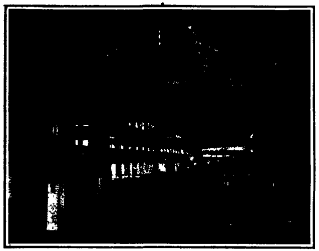


The air blast is heated in the hot stoves before entering the blast furnaces.

Steel rail and concrete foundations for the hot stoves

The power for operating the Gary plant consists of huge gas engines driven by the furnace gases.

Dust catchers and washers for purifying the furnace gases



Here the ingots are heated in gas-fired underground furnaces to the proper temperature for rolling

The soaking pits.

Contains 17 gas engines each of [illegible] horse power

Gas-driven 60,000 horse power electric power plant

The molten metal from the furnaces is brought to the open hearth furnaces [illegible] one of which is here shown

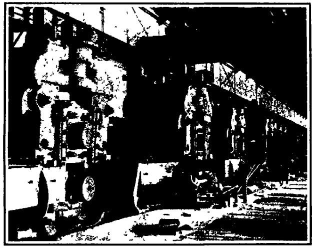
Charging platform of the open hearth furnaces.

On Sundays and holidays the hot metal from the blast furnaces is cast into pigs.

Interior of the pig-casting machine building.

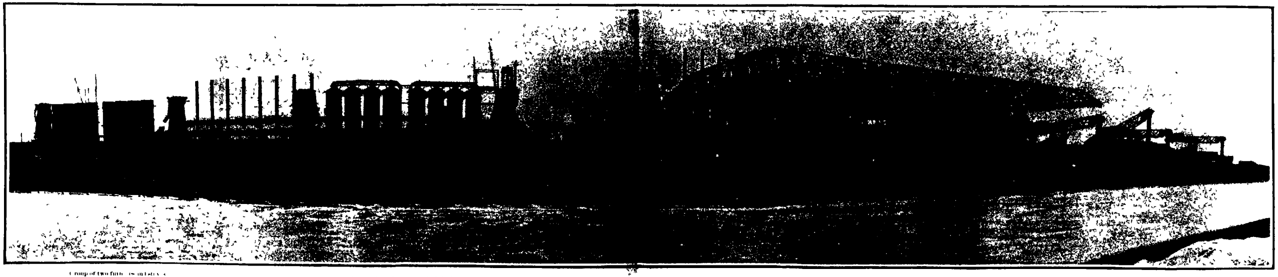
This mill, the largest in the world, can roll 4,000 tons of rails in a single day

Three-high rolls in the rail mills.



Contains four 40-inch blooming mill stands each driven by a [illegible]-horse power electric motor and a [illegible]-inch mill driven by a 8,000-horse power motor

View of the billet mill



Group of two furnaces in [illegible]

Group of two furnaces with their stoves

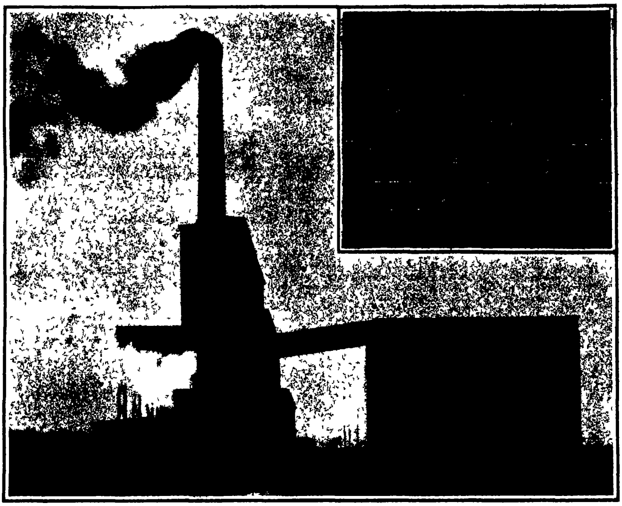
Five traveling conveyer bridges for transporting the ore to stock yard and furnaces.

Five unloaders for transferring ore from steamers

PANORAMIC VIEW OF GARY STEEL PLANT TAKEN FROM THE ARTIFICIAL HARBOR, 5,400 FEET IN LENGTH, WHICH HAS BEEN EXCAVATED FOR THE ADMISSION OF THE LAKE ORE STEAMERS

The Handling and Storage of Our Huge Grain Crop.

Few people outside of those who are connected with the gathering, handling, transportation and distribution of our grain crop appreciate either its magnitude or the wonderful plant and organization which are required for its transfer from the farm to the consumer's table. The latest available statistics are those for the year 1908, and they give the crop return as follows: corn, 2,612,687,000 bushels; spring and winter wheat, 659,030,000 bushels; oats, 789,161,000 bushels. Adding to these totals those for barley, rye, and buckwheat, we get as grand total for the year 4,304,689,000 bushels.



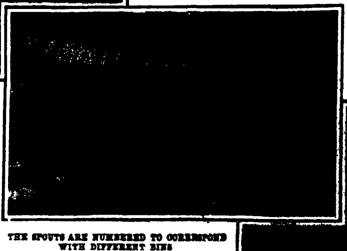
The working house. Upper view shows building of the concrete bins.

SANTA FE ELEVATOR AT ARGENTINE, KANSAS. CAPACITY, 1,000,000 BUSHELS.

BELT CONVEYER AND TRIPPING MACHINES FOR DISCHARGING WHEAT FROM BELT

In view of these figures one can readily understand that the acreage in the United States which is devoted to the raising of maize, wheat, etc., has about trebled during the past thirty years. The increment has taken place chiefly in the great Middle West, and more particularly to the west of the Mississippi River, in the Dakotas, in western Kansas, and in California, Oregon and Washington. The section of the United States which includes these new farm lands is one of magnificent distances. The fields of golden grain are scattered over an area that is measured by square miles in the hundreds of thousands. When the fostering care of the farmer has brought the grain to its full maturity, he is confronted with the tremendous problem of finding not only a market, but one in which the price will be amply remunerative for his twelve months of labor. These four billion bushels of grain must be gathered together to certain distributing centers and thence sent out to the millions of consumers who are scattered throughout the habitable globe. It is evident at a glance that in this, as in every problem of a commercial character involving the handling of a vast tonnage made up of widely scattered units, the question of profits will be directly determined by the systematic skill and suitable machinery and plant employed for such a colossal task. The solution of the problem has been found in the American elevator and the distinctively American system of freight transportation by railroad. Both of these have been developed along lines which have enabled the United States to handle wheat with an economy and dispatch which is not to be matched in any part of the world.

By way of illustrating the methods by which our grain crop is handled, we will follow the course of a consignment of grain from a farm on the western prairies across the broad American continent and out to sea.

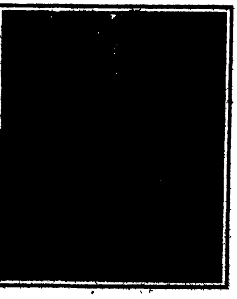


THE SPOUTS ARE NUMBERED TO CORRESPOND WITH DIFFERENT BINS

In the description which follows we wish to express our indebtedness to the John S. Metcalf Company, engineers, of Chicago, for photographs and descriptive matter of several of the huge elevators which they have built for various companies.

The first step in the journey is seen in the farmer's wagon jolting with its load of wheat along a country road, let us say in Dakota, to the nearest railway siding. Here the wagon is driven up an incline leading into a plain wooden structure measuring twenty by twenty-four feet and extending some forty-five feet into the air. This building is the primitive grain elevator, known as the "receiving house." He has no sooner halted his wagon than the fore wheels are raised and the hinder ones depressed, so that his load falls through a trap door into a cleaner, where the wheat is relieved of foreign matter—leaves, bits of straw, twigs, etc.—and then is emptied into the boot of an elevator leg. The leg, which is essentially the same for all elevators, large or small, consists of an endless rubber belt running over two pulleys, one in the boot at the bottom, and the other in the head. Upon the belt are fastened at regular intervals small metal cups facing in the direction in which the belt travels. As the pulleys revolve, the cups scoop up the grain from the boot, carry it to the head, and as the cups are inverted in passing over the strap pulley, empty it into a spout placed there to receive it. The legs of these small country elevators can lift a thousand bushels an hour, the legs in the huge elevators at Chicago, Buffalo, or other great elevator centers, can lift as much as ten thousand bushels an hour. As the grain is delivered from the head of the elevator, it descends through wooden spouts into four grain bins from ten to twelve feet in depth, which form the main part of the building.

The next step is to load the wheat into the freight cars, which are shunted upon a siding adjoining the elevator. The operation is simple. The grain is drawn from the bottom of the bin into the boot of the elevator, lifted to the top of the house, weighed in hoppers, and then allowed to flow by gravity through a spout into the cars. These are the essential operations of all grain elevators, big or small, whether the building is built to accommodate five thousand bushels or two millions. From the receiving house the cars are hauled to one of our great Middle West cities, such as Kansas City, St. Louis, or, as would probably be the case, Chicago. In conjunction with other trainloads of wheat they will finally be rolled alongside of, or into a covered way beneath, a huge structure 300 to 500 feet in length, 250 to 400 feet in width, and towering 150 feet



SPOUTS FOR DISTRIBUTING GRAIN TO THE BINS.

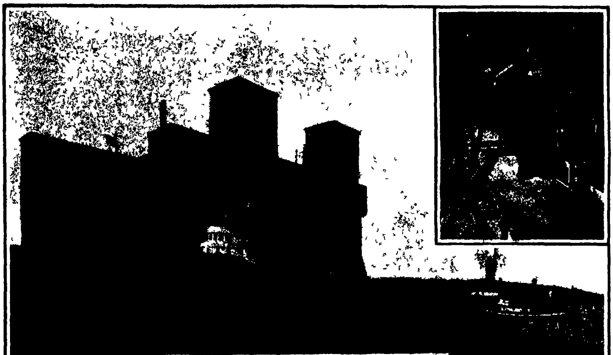
into the air. If it be one of the older buildings of its kind, it will be built of timber, but if it be of the latest construction, such as that shown in our illustration of the 2,000,000-bushel elevator for the Grand Trunk Railway at Tiffen, Ontario, or the Santa Fé elevator at Chicago, Ill., of 1,500,000 bushels capacity, it will be built of brick, or tile, or reinforced concrete, this last being the material employed in the two elevators referred to. An elevator of this character is actually a huge warehouse for grain, which is designated by a registered title, is inspected and licensed by the State, and is under the close supervision of the city Board of Trade. Before admission into its bins the grain must be carefully weighed and classified, and when it has once been placed there, the warehouse receipt becomes to all intents and purposes in the money market, the grain itself. It is as easy to deal in it in the market as it is to transfer money in a bank from one account to another. Although the length of time that the five thousand bushels which once filled the little receiving elevator will lie in these bins at the great warehouse depends upon circumstances, the period of its sojourn is a very restless one—restless not for the grain itself, but for that negotiable slip of paper which stands for its sign manual in the market. This may journey hither and thither from seller to buyer until in a short space of time it may happen that our five thousand bushels have been sold and bought, and sold yet again, and that by the mere flick of a man's finger.

Arrived at the great city elevator, the car doors are rolled back and our five thousand bushels of grain are immediately attacked by what is known as the "power shovel." This consists of a large two-handled scoop, to which is attached a rope that is wound upon a rotating drum.

The drum is so fixed upon its shaft that when the man at the shovel walks away with the latter the drum readily unwinds, but as soon as he stops the drum commences winding up the rope and hauls the scoop back to the point at which it started. There are a pair of these shovelers to each car, and they carry the scoop back, bury it in the wheat and guide it as it is pulled forward out of the door of the car and discharges its contents into a hopper that leads to the boot of a huge elevator leg. Two of these shovelers can unload from the cars thirty thousand bushels of grain in a single day.

Now although we have stated that the little receiving house contains all the essential principles of construction and operation of the big city elevator, the likeness is only a general one. The latter are enormous affairs, the greater part of whose bulk is taken up by the grain bins. These in the older elevators were always square in section and some sixty feet in depth. A typical one of this kind is one belonging to the Armour Elevator Company at Chicago which receives grain from the Milwaukee road. It is 550 feet in length and 156 feet high. It can unload 500 cars of wheat per day and can deliver 100,000 bush

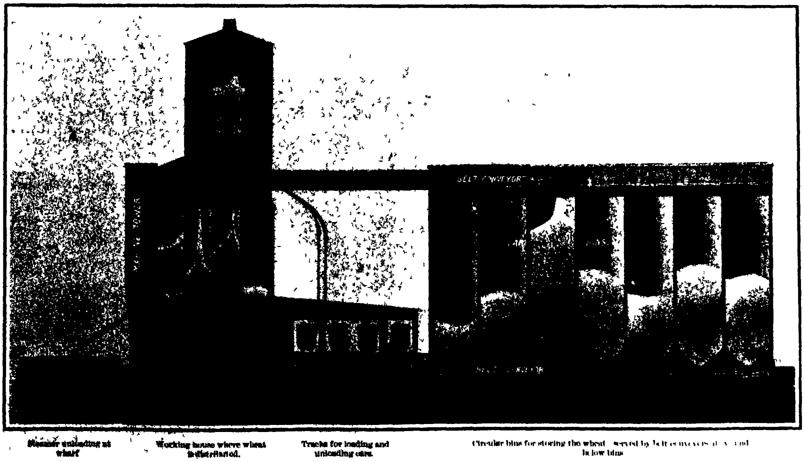
(Continued on page 451.)



The steamship is being unloaded by tower legs.

TWO MILLION BUSHEL CONCRETE ELEVATOR OF GRAND TRUNK RAILROAD.

SPOUTING AND BELT CONVEYER ABOVE STORAGE BINS.


BELT CONVEYOR
Steamer unloading at wharf
Working house where wheat is distributed.
Tracks for loading and unloading cars.
Circular bins for storing the wheat served by belt conveyors above and below bins

SECTIONAL VIEW OF THE SANTA FÉ ELEVATOR AT CHICAGO.

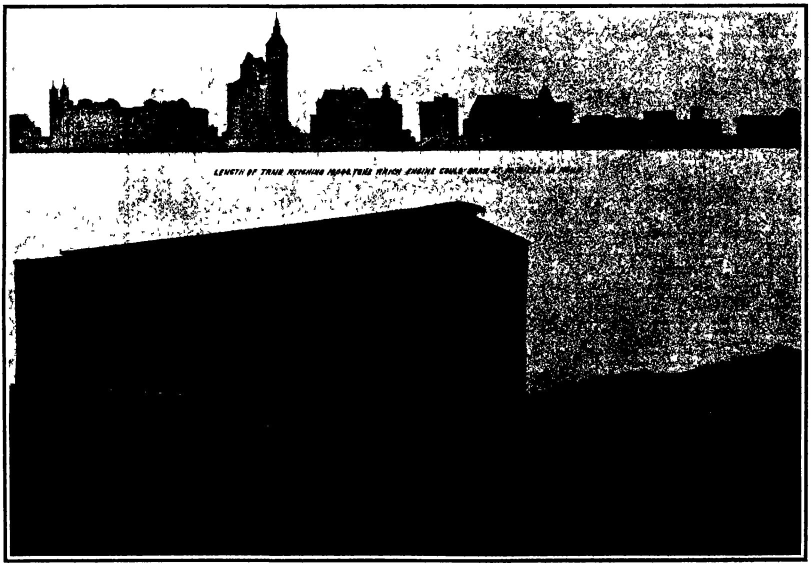
Chicago and the Railroad System of the Middle West.

The Capital of the Middle West.—When the first American settler John Kinzie, the Indian trader established himself at the mouth of the Chicago River in the year 1803, he little imagined that he was responsible for the beginnings of one of the greatest cities in the world, nor did he know that he had accidentally hit upon the very spot which by virtue of its geographical location was destined to become the greatest railroad center in the world On the other hand to do justice to this first settler it should be mentioned that the spot which he chose for the home of himself and family was a center even at that early day well adapted for such trade as came his way, for as far back as the early days of French exploration, the Chicago river formed part of a line of travel by which the Indians reached the Mississippi River By journeying up the river and its south branch a portage of some four or five miles brought the Indians across the divide and enabled them to launch their canoes on the Des Plaines River down which they could pass to the Illinois River and so to the great Mississippi It is interesting to note in this connection that the Chicago Drainage Canal a splendid waterway 22 feet deep and from 110 to 202 feet wide follows approximately this old Indian trading route

Whether or no John Kinzie had any conception of the great strategical importance of the place which he had selected to make his home and drive his bargains subsequent history has shown that this lonely spot in the remote wilderness was destined to become the greatest meeting and distribution point of that wonderful network of railways which has grown up so rapidly over the whole face of the United States On the opposite bank of the river from the Kinzie home the United States government located Fort Dearborn a mere stockade containing two blockhouses the first garrison of which consisted of one company of infantry of the First Regiment The settlement at Fort Dearborn made but little growth until after the war of 1812 and in 1830 it consisted of a hamlet of log houses tenanted by less than one hundred people In 1827 Congress authorized the construction of the Illinois and Michigan Canal, and the State was granted alternate sections of land on both sides of the canal route The commissioners proceeded to lay out towns, one of which was Chicago, which was located at the eastern terminus of the canal. The lands were thrown open for purchase in the year 1830 Buildings were erected, and a movement of settlers at once commenced, chiefly by way of the lakes and largely from New York and the New England States. In 1833 Congress made an appropriation for a harbor at Chicago, a channel was cut through the sandbar at its mouth, and in 1834, for the first time, a schooner sailed up the river Three years later the town was incorporated as a city with a population of 4 170

The canal failed to fulfill the high hopes with which it had been constructed, and indeed it was not finally completed until the year 1848, but a new method of transportation was at hand which was destined to do for Chicago and the surrounding country all and far more than had ever been promised by the canal In the year 1847 the first mile of railroad (running toward Galena, Ill) was commenced, and three years later there were forty two miles of connecting lines. In February of 1852 the city was connected with the East by the Michigan Southern Railway, and in the following May by the Michigan Central The effect upon the growth of population was instantaneous. Although between 1837, the year of its incorporation, and 1840 the city had increased only from 4 170 to 4,479 in population, the inception of railroad construction proved such a powerful stimulus that by 1850 Chicago had a population of 28,269, by 1860, of 109 206, and by 1870, of 306 605 Then, in 1871 came the Great Fire That terrible disaster, by all the logic of human events should have dealt a death blow to the city or at least have retarded its growth for many a decade to come. Three and a third square miles of the city were swept out of existence and property valued at $187,000,000 was destroyed, but so far from checking the growth of Chicago the disaster served merely to demonstrate the latent resources of the city, and the unbounded faith both of its people and the country at large in its future destiny The wreck of the wooden city was quickly swept away, and within two years the burned area was covered with buildings of the most modern type, furthermore, nine years after the disaster Chicago had passed the half million mark with a population of 503,298. In the next ten years, the population had more than doubled, the census of 1890 showing 1,105,540. In 1900 it had grown to 1,698,575 souls; and the city's area, which in 1837, the year of its incorporation, was 2 55 square miles, had increased to 190 638 square miles. To-day the population of Chicago is estimated to be 2,373,900, and the assessed valuation of all taxable property is $477,921,976

Chicago the Greatest Railroad Center in the World.—It takes but a look at the railroad map of the United States to understand why Chicago is to-day, and has been for many years, the greatest railroad center in any country Situated at the southern end of Lake Michigan, which projects far down into the great empire of the Middle West, it not only intercepts all the great trunk railroads, which reach with their connections from the Atlantic to the Pacific, but it forms a natural meeting and transfer point for those products of the West, which seek the advantage of water transportation to and from the East afforded by the chain of Great Lakes In the opening up of the vast unoccupied regions of the West and Middle West, Chicago, in common with St. Louis, formed a natural starting point for the pioneers and immigrants who were seeking to better their fortunes in a new and undeveloped country In this work of development, the railroad was always the predominant factor Starting from Chicago, lines began to radiate out over the wide and fruitful areas of the great Mississippi Valley, across the vast prairies, which awaited only the plowshare and the husbandman to develop their latent fertility, and into the far-distant Rockies, where lay hidden a vast store of mineral wealth. On the other hand, the eastern railroads, as they pushed their way across the range of mountains which separates the older eastern States from the great Middle West, naturally laid their course for Chicago as the natural point of connection with the rapidly extending railroad systems of the West. Meanwhile, the discovery of gold in California, and the increasing enlightenment as to the natural resources in timber and agricultural land of the country lying between the Rocky Mountains and the Pacific coast, had led to an extensive immigration by sea and overland into that country Railroads were built upon the Pacific coast; and it was not long before the systems of the Middle West began to push boldly through the Rocky Mountain range, with a view to securing transcontinental connections. The completion of the first road of this character, the Union Pacific, was


LENGTH OF TRAIN WEIGHING 10000 TONS WHICH ENGINE COULD DRAW AT 10 MILES AN HOUR

This huge Baldwin freight engine, weighing 300 tons, was built for the Southern Pacific Railroad. It is capable of hauling at 10 miles an hour a train of 130 cars weighing, with load, 78 tons each The train, weighing 10,000 tons, would reach for over a mile or say from City Hall Square to the Battery New York The lower cut represents the size of a single car, 200 feet by 48½ feet by 60 feet, that would be necessary to contain the load of wheat handled.

THE MOST POWERFUL FREIGHT ENGINE AND THE LOAD IT CAN HAUL.

lowed by the building of the Northern Pacific, the Atchison & Santa Fé, the Great Northern, and this year the Chicago, Milwaukee & St. Paul completed its transcontinental connection. Meanwhile, a great north-and-south route was being built in the Mississippi Valley, which ultimately developed into the present Illinois Central Railway, by which direct communication is afforded from Chicago to the Gulf.

It is impossible within the limits of the present article to enter into the history of the development and growth of the complicated network of railroads which is directly tributary to Chicago, but the claim of the city to be the leading railroad center is suggested by the following table, which gives the number of through and suburban trains into and out of Chicago and the name and mileage of the various tributary roads. It will be seen that out of a total mileage of about 225,000 miles of the whole of the United States, nearly one-half, or 100,123 miles, is directly tributary to the city, and that, over these roads, a total of 1 294 trains enter and leave the city daily

RAILWAYS TRIBUTARY TO CHICAGO

Number of Trains In and Out of Chicago. Thro.	Number of Trains In and Out of Chicago. Suburban.	Name of Railway	Mileage.
19		Atchison, Topeka & Santa Fé	9 976
10		Baltimore & Ohio	4,447
29		Chicago & Alton	998
37	76	Chicago, Burlington & Quincy	8 950
84	206	Chicago & Northwestern Line	9,665
10		Chicago Great Western	1,457
	12	Chicago Terminal & Trans. Co	358
12		Chicago, Indianapolis & Louisville	578
4		Chicago, Cincinnati & Louisville	284
	21	Chicago & Western Indiana	50
11		Chicago & Erie	2,383
81	14	Chicago, Milwaukee & St. Paul	8,659
11	12	Grand Trunk System	6,212
46	252	Illinois Central . .	6,201
45	91	Chicago, Rock Island & Pacific	7,525
		New York Central Lines, including	
25	48	Lake Shore & Michigan Southern	12,524
31		Michigan Central	
6		Chicago, Indiana & Southern	
10		Minneapolis, St. Paul & Sault Ste Marie	3,889
		Pennsylvania Lines, including	
24	22	Fort Wayne Route	11,285
16		Pan Handle Route	
8		Pere Marquette	2,318
22		Wabash Railroad	2,514
541	753		100,123

Receiving and Distributing the Freight.—Elsewhere in the present issue we have spoken of the productiveness of that great empire of the Middle West of which Chicago is the capital Spread out over the twelve States, which in government reports are known as the North Central Division of the United States, with their area of 753,550 square miles, and their population of over 30,000 000, are between 85 000 and 90,000 miles of track Within this area is more than one-half of the wealth invested in improved farms in the United States, and over one-half of the live stock and neat cattle It produces 78 per cent of the total food products and more than one-half of the butter cereals, potatoes, and poultry that are raised in the entire country Although distinctly an agricultural district, it is rapidly moving forward to its ultimate position as the leading manufacturing center Already it possesses 190,000 manufacturing establishments representing an invested capital of over $3 000 000 000 which pay out annually between $700,000,000 and $800 000 000 in wages, and the value of whose annual products is about $4,500 000,000, or about 35 per cent of the value of the products of the whole country As far back as 1905, the total output of bituminous coal was 81 000 000 tons, or over 32 per cent of the total amount of bituminous coal mined in the United States That Chicago is the center to which the products of the West and Middle West are carried for distribution and reshipment is shown by the statistics of the Chicago Board of Trade for 1908, from which we learn that in that year the railroads brought into the city over 10 000 000 barrels of flour and 239 000 000 bushels of wheat corn oats, rye, and barley of which over 9,000 000 barrels of flour and over 180 000,000 bushels of cereals were reshipped by lake and railway In the same year over 3,000,000 cattle and 8,652,000 hogs were received at the stockyards by rail. Of potatoes over 12 500,000 bushels, and of hay some 300,000 tons were brought in, mainly by rail Limits of space prevent any further statement of statistics, but enough has been quoted to give an adequate impression of the enormous quantity of freight which day by day enters the city either for home consumption or for reshipment to other ports

Chicago has solved the problem of redistribution and reshipment admirably by the construction of a belt railroad, which extends around the city, and connects with each of the railroad freight terminals. As the trains roll into the various yards, they are broken up, and the various cars sorted out and rearranged according to the particular railroad over which their journey is to be continued, or the particular point within the city at which delivery is to be made. The resorting of the cars is done in some cases by gravity, the cars being started down a gentle incline, at the bottom of which the track communicates by switches with scores of parallel tracks, on which the separate trains are made up This railroad is a complete organization in itself, possessing its own locomotives, train hands, and office staff, and the system of distribution is probably the most efficient of its kind in the world In this connection it is interesting to note that within the limits of the city of Chicago are more miles of railroad track than some States contain within their borders Altogether 2,494 59 miles of track are owned by eighteen of the twenty-six lines which center in Chicago

Chicago's Sixty Miles of Freight Subway.—The Illinois Tunnel Company owns and operates sixty miles of subway for freight traffic under the business heart of Chicago Connections are made with all of the principal freight and passenger stations of the city and with the docks on the three branches of the Chicago River There are also connections with the basements of many of the leading wholesale retail and manufacturing industries of Chicago A disposal station is situated on the west bank of the Chicago River from which vast quantities of excavated material refuse and other waste are loaded on scows and transported to final dumping grounds away from the city The direct connection of the freight subway and this disposal station saves hauling through the streets of Chicago thousands of tons of waste material The tonnage of freight handled to and from the railways through the tunnel has shown a steady increase during the last six years, and has decreased the hauling by teams through the city Whether the bore of this tunnel will be enlarged to accommodate passenger traffic as well as freight traffic is one of the problems now under consideration, but it seems reasonable to expect that a start will be made in the near future on some plan to handle the immense passenger business within the city underground and thereby relieve the congestion of the streets

Railway Terminal Facilities.—Until recently the terminal facilities for passenger service in Chicago have not been commensurate either with the importance of the city or with the size of its passenger traffic This condition, however, is being fully corrected The president of the Pennsylvania Railroad recently announced that a new station would be built in Chicago, and that the work would be started at an early date and pushed to completion as rapidly as possible The cost of the new Union Station is to be about $25,000 000, and it will be occupied by the same railroads that now use the Union Station the Pennsylvania, the Chicago, Milwaukee & St Paul the Chicago & Alton, and the Chicago, Burlington & Quincy

The Northwestern Railway is completing a $20,000,

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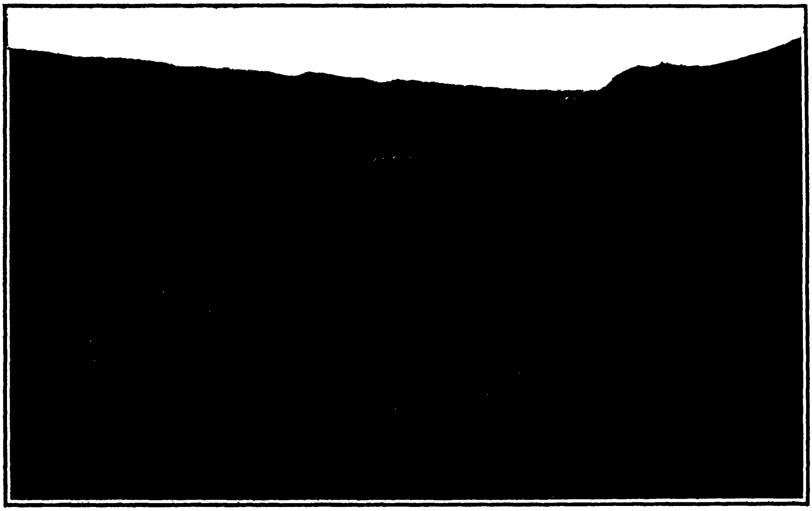


This line, the latest to be constructed to the coast, is 2,175 miles in length, was built within the brief space of 28 months.

Bridge across the Missouri River at Lombard, Montana.

THE EXTENSION OF THE C, M & ST P RAILROAD TO THE PACIFIC COAST.

IRON THAT WILL NOT RUST.

In 1856 Sir Henry Bessemer invented a process of steel making which revolutionized the iron and steel business. By this method it was possible to turn out an immense tonnage at a low cost and with a low percentage of carbon and manganese. To be able to produce in large quantities and at a low cost a metal which had even greater tensile strength and ductility than good iron at once enabled steel to take the place in commerce hitherto held by iron.

While steel had a greater tensile strength and greater rigidity than iron it had certain limitations which have grown increasingly apparent. These limitations appear in the use of steel where it is subject to severe corrosive agents, as, for example, in the atmosphere of cities impregnated by the fumes of gas or coal smoke, at the seashore with its salt air, in the ground with its dampness, or in localities where it becomes the intermittent conductor of electrical currents. Steel has come to be considered under these conditions and notwithstanding its extreme hardness of texture a comparatively short lived metal.

Iron nails taken from demolished houses that were built in the eighteenth century are handed about as curios for to-day. In many a shingled roof the shingles outlast the steel nails. The Department of Agriculture voiced the sentiments of the farmer when it urged upon wire makers the necessity of improving the character of the wire fence so that the farmer using it would not have to renew it every five to nine years. The thrifty housewife, pleased with the beauty and strength of her new galvanized water pail, is surprised and indignant at having her maid call her attention, as it seems to her after a very short time, to the holes in the bottom.

It is generally considered a plausible, if not demonstrated, theory that this fugitive nature of steel comes from its chemical structure. The elements introduced into the molten mass of iron in the furnace and in the ladle to convert iron into steel are essentially impurities. Under certain conditions an electrolytic action is set up within the structure of the steel between these impurities, with a resultant disintegration of the metal.

There is a growing conviction that the corrosion of metals is due to this electrolytic action. According to the latest theory, rusting commences on the surface of the metal because of a difference of potential there, a condition which is due to the impurities in the metal, such as carbon, sulphur, phosphorus and particularly manganese. Dr. A. S. Cushman, in a pamphlet entitled "The Corrosion of Fence Wire," published by the United States Department of Agriculture, arrived at the conclusion that steel corroded more rapidly than iron for several reasons, chief among which were the following:

First. The presence of and the irregular distribution of manganese in steel, there being little if any of that substance present in iron.

Second. The greater destruction of steel by electrolysis as compared with iron, due to the presence of manganese and various metalloids in greater quantities than in iron.

Third. The absence of slag in steel, whereas the slag distributed throughout iron was believed to act as a rust preventive.

The same authority says: "If we accept the electro-chemical explanation of the corrosion of iron, there can be no doubt that conditions which inhibit electrolytic effects also inhibit corrosion, and *vice versa*. The purer the iron in respect to certain metals which differ electro-chemically from iron, and the more carefully the lack of homogeneity and bad segregation are guarded against, the less likely are the electrolytic effects to become serious. These points constitute the essential problems which confront the manufacturer who desires metal that will have a high resistance to corrosion."

A few years ago the American Rolling Mill Company, of Middletown, Ohio, began to investigate the possibility of producing from their open hearth furnaces, from which they were making high-grade steel by the usual method, a steel very low in carbon and manganese. The success achieved in this direction suggested that it might be possible to reduce the scrap and pig iron to a molten mass in an open hearth furnace and cast it into ingot iron without introducing the impurities that are known to be active agents in corrosion.

In making steel by the open hearth process, the furnace is charged with many tons of selected scrap and pig iron, and the charge is raised to a sufficient temperature to burn out the carbon and the greater part of the other impurities. When these have been reduced to the desired extent, a predetermined amount of carbon and, in particular grades of steel, of other ingredients is added to the molten metal until its composition has been brought to the exact point called for by the specifications for the particular grade of steel which is being made. In the experimental work of the company above referred to the treatment was entirely one of elimination, the effort being to get rid of practically the whole of the impurities, and bring the metal as nearly as possible to the condition of absolutely pure iron. They carried the process of burning out the impurities even further than is done in the manufacture of commercial steel, and there the process stopped, leaving in the bath a remarkably pure iron, which was subsequently cast into ingots and was available for use in the rolling mills and elsewhere for manufacture into commercial products.

An analysis of this iron in comparison with commercial steel, as made by William M. McPherson, professor of metallurgy, Ohio State University, Columbus, Ohio, showed the following results:

	Steel	American Ingot Iron
Sulphur	0.048 per cent	0.021 per cent
Phosphorus	0.094 per cent	0.005 per cent
Carbon	0.11 per cent	0.02 per cent
Manganese	0.47 per cent	Trace
Silicon	Trace	Trace

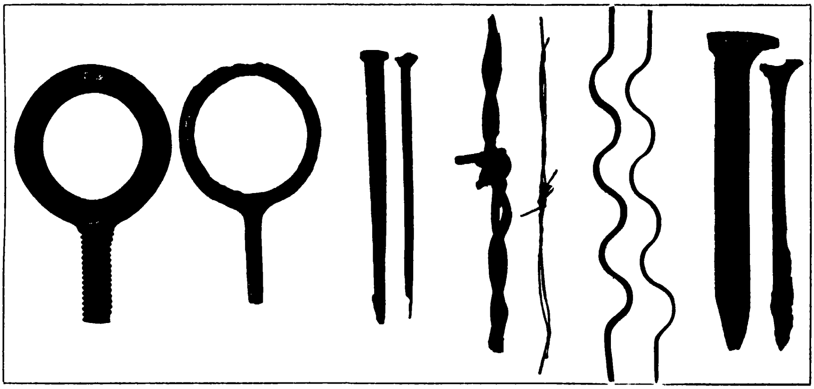
The corrosion test of the above samples, which were immersed in a 5 per cent solution of sulphuric acid for twenty-four days, showed:

Loss, steel	14.41 per cent
Loss, American ingot iron	0.21 per cent

"The above material," says the report, "is very exceptional for its purity, and is the most non-corrosive material that I have examined."

Four specimens of ingot iron subjected to tests to determine its tensile strain showed the following results: Breaking strain per square inch, from 49,857 pounds to 51,905 pounds; limit of elasticity per square inch, from 35,395 pounds to 41,377 pounds; elongation per cent of length, from 40 per cent to 48 per cent.

We present a set of comparative illustrations, showing the results of corrosion tests on various articles of commerce, one of each pair being made of the new ingot iron, and the other of steel or other material. In every case, both specimens were immersed in a bath of 25 per cent sulphuric acid. The ingot iron and charcoal eyebolts were treated in the bath for six hours, at the end of which time the ingot iron eyebolt showed a loss of 15.5 per cent, and the charcoal iron eyebolt a loss of 77.3 per cent. In a five-hour test of two railroad spikes, the ingot iron specimen lost 11.2 per cent, and the steel spike 79.1 per cent. Even more remarkable was the comparison of ingot-iron and barbed-wire fencing material, the steel wire losing 92.8 per cent at the end of one and a half hours and the ingot-iron wire losing only 6.1 per cent. In a forty-five minutes' test of two nails, the steel nail lost 68.9 per cent, and the ingot iron nail 4.13 per cent. The two specimens of corrugated roofing material were placed in the bath for fifty minutes, at the end of which time the steel specimen had lost 78.2 per cent, and the ingot iron 2.4 per cent.



Ingot Iron Loss, 15.5%. | Charcoal Loss, 77.3%. | Ingot Iron Loss, 4.13%. Steel Loss, 68.9%. | Ingot Iron Loss, 6.1%. Steel Loss, 92.8%. | Ingot Iron Loss, 2.4% Steel Loss, 78.2%. | Ingot Iron Loss, 11.2%. Steel. Loss, 71.9%.

CORROSION TESTS IN BATH OF 25 PER CENT SULPHURIC ACID

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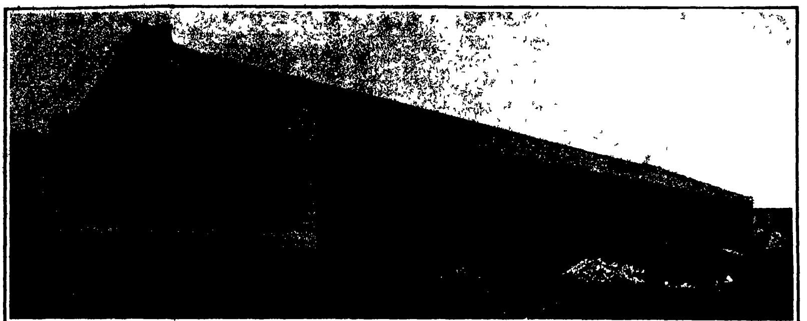
CHICAGO'S SIXTY MILES OF FREIGHT SUBWAY.

In our Engineering Number of December 5th of last year we illustrated a system of freight subway which had been proposed for solving the serious problem of freight congestion on the streets of this city. In the present Middle West Number we present illustrations of a complete system of freight tunnels, aggregating sixty miles in length, which has been completed below the business center of Chicago, and is now regularly engaged in conveying merchandise and the city's mail directly to and from the railways, the Post Office, and the various office and commercial buildings of the city. The Chicago freight tunnels stand as a unique achievement among the great municipal undertakings of the world, and the capital city of the Middle West very justly prides itself upon the magnitude and completeness of this constructive work, which ranks in importance with that other great Chicago enterprise, the Drainage Canal.

The underlying conditions which have led to the construction of the subway are the same as those that have prompted two powerful construction companies to make an offer to build a similar freight subway system beneath New York city, namely, the intolerably congested condition of the street traffic. It is the slow moving and bulky dray and the various freight and express vehicles that are chiefly responsible for the growing street congestion in the business centers of our great cities. It is claimed that, before the construction of its tunnel system, the conditions in the heart of Chicago were worse than in any other city.

(Continued on page [illegible].)



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Wrought Steel "Detroit Fenestra"

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Type "A" in 21 sizes and degrees of ventilation, 10" x 16" glass
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Type "C" in 6 sizes, 12" x 18" glass, large ventilation
Type "M" in 2 sizes, 12" x 18" Ventilated Monitor Sash

All these standards are made as interchangeable units, and mullions are supplied where they are to be used in combination

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Indiana Steel Co. (U. S. Steel Corporation) Gary Ind.
Jenks & Muir Mfg Co., Detroit, Mich
Reinforced Concrete Pipe Co., Detroit, Mich.
Allyne Brass Foundry Co., Cleveland Ohio.
Mitchell Motor Car Co., Racine, Wis.
Western Motor Company Marion Ind.
Carnegie Steel Co. Bellaire, Ohio.
Michigan Alkali Co., Wyandotte, Mich.
American Optical Company Southbridge Mass
Pennsylvania Railroad Co., Philadelphia, Pa.
American Sterilizer Company Erie, Pa.
Bethlehem Foundry & Machine Co., Bethlehem Pa.
El Paso Power Station El Paso Texas.
C. T. Patterson Warehouse New Orleans, La.
Holophane Glass Co., Newark Ohio
New York Central & Hudson River Car Shops, West Albany N. Y.

DETROIT STEEL PRODUCTS COMPANY, Manufacturers, Detroit, U. S. A.

THE WONDERFUL IRON MINES OF LAKE SUPERIOR.

(*Continued from page 431.*)

the Panama Canal as the greatest task of its kind ever undertaken, yet it is a fact that at the close of the present year the stripping of the surface material and the excavation of the ore from the Mesabi range alone during the seventeen years that mining has been carried on will represent a total of excavation equal to that required for the Panama Canal

Transportation of the Ore.—Apart from the easy accessibility of the ores, particularly in the Mesabi range, the low cost at which the iron ore is delivered to the railroad cars or on the stock pile at the Lake Erie ports is due in a large measure to the present system of mechanical handling and transportation which enables a huge tonnage to be moved in a minimum of time and for a minimum of cost. From the time the ore is lifted by the shovel in the "open pit" mine, or is loaded into the skip of the deep underground mine, it is handled entirely by mechanical means and no human hand comes in contact with it. The trains of ore cars, as they arrive at the Lake Superior ports, are run out directly above long elevated docks, consisting of continuous rows of ore bins. The hinged bottoms of the cars are released and the loads dropped into the ore pockets, where the material remains until the ships steam alongside for loading. Hinged to the bottom of the ore pockets are long rows of metal chutes, and as a chute is lowered into position over the hatch of the steamship, the gate at the bottom of the ore pocket is opened, and the ore slides by gravity into the hold. The ore-shipping piers of the Great Northern Railway at Superior are capable of receiving and loading from five to six million tons of ore in a season, and they have a record of loading a ship of 5,250 gross tons in 30½ minutes. An even greater feat was the loading of the steamer "H. E. Corey," of 10,000 tons capacity at Duluth and Iron Range steel ore dock at Two Harbors, Minn., this season, in 39 minutes. One of the piers of the Great Northern Railway Company is 73 feet above water level 62½ feet wide, nearly half a mile in length, and has a storage capacity for 87,500 tons. The construction of a special type of ship of large tonnage for the ore trade coupled with the invention of unloading machinery of great capacity at the terminal ports, has brought the cost of transportation down to a very low figure. Thus, a ton of ore is now hauled one hundred miles by rail from the most distant mines in the Lake Superior range to a Lake Superior port is loaded into the ship, is carried one thousand miles by water and unloaded into cars or onto the stock pile at a Lake Erie port, at a cost of less than $1.80 per ton

The iron-ore steamer of the Great Lakes has been designed with a strict reference to the economical loading, transportation and unloading of iron ore in bulk. Its characteristics are great length, moderate draft, and a huge cargo hold which extends continuously for nearly the whole length of the vessel, and is provided with a continuous row of hatches extending the full length of the hold. We present an inboard profile and a cross section of the "Wolvin," one of the largest of the typical ore steamers. This vessel is 560 feet in length, 56 feet beam, and 32 feet deep. The cargo hold is built in the form of a long hopper whose sides slope from the main deck to the top of the ballast tank. The hopper is 48 feet wide at the top 24 feet wide at the bottom, and extends continuously for a length of 409 feet. The space between the hopper and the outside of the vessel forms two series of water-ballast tanks, the ballast space being divided into compartments by athwartship bulkheads built in at intervals of 60 feet. The tanks have a maximum capacity of 8,000 tons of water. Transverse stiffness is afforded to the sides of the vessel by a system of arched girders, which also serve to support the upper deck and the hatch covers. Between the girders are 33 hatches, each of which measures 9 feet by 33 feet in the clear. The largest single cargo of ore carried by the Wolvin was 11,536 tons, a feat which she performed in 1904. The pilot house bridge and captain's quarters are forward at the bow. Aft of the cargo space are the coal bunkers boiler room engine room, and the quarters for the crew

Great as are the dimensions of the 'Wolvin' they have been exceeded regularly in each succeeding year. The 'E. H. Gary' in 1905 carried a single cargo of 12,368 tons in 1906 the 'J. P. Morgan' carried a single cargo of 13,272 tons of ore and in 1907 she carried 13,800 tons. Equally remarkable for size are some of the sailing cargo ships the most notable of which is the John Smith which in 1907 carried a single cargo of 9,408 tons.

It is the magnitude of the ore trade which has made the Sault Ste. Marie canal the most important artificial waterway in the world at least in respect of the bulk of tonnage passed through. According to figures given at the thirteenth annual meeting of the Lake Superior Mining Institute, the maximum freight traffic through the canals for a single day was on August 26th 1907 when 487,000 tons were passed through in 121 vessels. The total traffic into and out of Lake Superior for that year was 58,217,214 tons, on which $38,458,345 were paid as freight charges. Of this total tonnage 68 per cent was iron ore

Unloading and Handling Machinery.—In order to keep pace with the low cost and speed with which the huge bulk of iron ore is mined, loaded into special steamers, and carried to its destination at the various Lake Erie ports it was necessary to design special unloading machinery capable of lifting the ore from vessels and loading it either into the stock pile or into railroad cars with proportionate speed and at a relatively small cost per ton. The design and construction of this class of machinery has grown to such importance that there are several large industrial concerns which are occupied almost entirely with this class of work. In one of our views illustrating the interior of the hold of the Wolvin and also in the general panoramic view of the water front of the Gary Steel Works we show what is known as a Hulett automatic ore unloader. Four of these machines located at the docks at Conneaut Ohio are credited with having taken out of the Wolvin 7,257 gross tons of ore in four and one half hours. At present there are five of the Hulett unloaders at Gary and when the plant is completed there will be ten. The plant consists of a massive walking beam to the outer end of which is pivoted a vertical arm. At the bottom of the arm is a bucket capable of lifting ten tons at each operation. As the bucket descends into the hold of the vessel the two halves open and are automatically moved apart in a horizontal direction so as to make a wide grab of the ore. The machines at Gary are carried on two tracks 62 feet apart and span two railroad tracks laid parallel to the edge of the dock. They are operated by electricity and each weighs about 450 tons and requires only three men for its operation. They are showing a capacity for unloading ore at an average rate of 300 tons per hour for each machine. As each bucket load is lifted it delivers the ore to a conveyor car which travels back to the rear of the machine and discharges its load into suitable hoppers at the rear

By the courtesy of the Brown Hoisting Machinery Company we are enabled

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to present photographic views of several types of unloading machinery as installed for the unloading of iron ore coal and other heavy materials in bulk at various ports on the Great Lakes During the recent meeting in New York of the Society of Naval Architects and Marine Engineers a paper was read on Material Handling Equipments for Lake Vessels which traced the development of this type of machinery from the year 1880 At that time dock managers were looking for some mechanical means for lifting the ore from the ship and depositing it at some distance from the face of the dock, and this was first accomplished by a cableway machine, built and erected at Cleveland in 1880 under Mr Alex E Brown's supervision From that first device have been developed the mammoth machines of the Brown hoist type They consist essentially of a long overhead bridge extending at right angles with the dock and supported on two towers, one at the dock the other 200 to 300 feet inshore Upon the bridge are rails, on which travels a self propelled trolley Upon the trolley are motors for hoisting the load and for moving the trolley to and fro upon the bridge In unloading the trolley runs out over the hold, the grab bucket descends and grabs its 5 to 7 tons of ore, raises it and then the trolley travels back to the stock pile, where the load is dropped

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GARY THE LARGEST AND MOST MODERN STEEL WORKS IN EXISTENCE

(*Continued from page 441*)

purified has an average heat value of 95 British thermal units per cubic foot

It is estimated that 2¼ times as much power can be derived from a given quantity of gas with gas engines as with boilers and steam engines

THE OPEN HEARTH FURNACES

The hot metal is tapped from the bottom of the furnaces into 40-ton ladles, mounted on massive eight wheeled trucks, which are hauled successively beneath the pouring spout When a train of ladles is made up it is hauled to the mixer building, which contains two huge receptacles each of 300 tons capacity Into these the ladles discharge the hot metal, and the mixing of the product of the different furnaces insures a uniform average of composition of the metal From the mixers which are arranged so that they can be rocked or tilted, the molten metal is poured into 60-ton charging ladles which are conveyed to the charging side of the open hearth furnaces on electric transfer cars From these cars the ladles are picked up by a 75 ton traveling crane and the metal is poured into the open hearth furnaces through a runner

The whole of the output of the Gary plant consists of open hearth steel and the open hearth furnace plant is by far the largest of its kind in the world It is housed in large steel-frame buildings 193 feet in width and 1 190 feet long Ultimately there will be six of these buildings each containing fourteen 60-ton furnaces, or eighty four furnaces in all To the molten metal with which each furnace is charged there is added a certain amount of steel scrap, and the charge is then subjected to the fierce heat of burning gases which enter at one end of the furnace pass over the charge, and leave through flues at the other end From time to time samples are taken from the furnace and tested The object of this treatment is the same as that of the air blast in the Bessemer converter, and though the operation consumes more time the product is very much more reliable The impurities are burned out of the metal until the proper percentage of carbon, etc for the particular grade of steel which is being made has been reached. The metal is now ready for pouring.

Down each side of the long line of open hearth furnaces is a set of railroad tracks on which the metal is brought to or removed from the furnaces, and handled thereat. On the tapping side on which the treated metal is withdrawn from the furnaces is a line of massive standards in which are placed the ladles of 80 to 100 tons capacity into which the metal is poured When they are full, the proper amount of ferro-manganese is added to the metal in each ladle, and they are then picked up by 125-ton traveling cranes and carried to platforms from which, by opening a plug in the bottom, the molten steel is poured into the ingot molds large cast iron molds 65 inches in height tapering from 20 by 24 inches at the bottom to 18¾ by 22⅞ inches at the top Here the metal cools to the point of solidification. The mold is then lifted off the ingots which by the way, are carried on four wheeled cars, each car carrying four molds, and after having been heated to a uniform heat throughout in the 'soaking pits' the product is ready for rolling in the billet mill or the rail mill

It should be mentioned that in order to take care of the product of the blast furnaces on Sundays and holidays, when the open hearth furnaces are not at work, the hot metal is brought in ladles to the casting machine, where it is poured into an endless chain of traveling molds which passes continuously below the mouth of the ladle. There will be eleven of these machines for the service of the complete plant

BILLET MILL.

Standing parallel with the rail mill is an electrically operated billet mill, in which a portion of the ingots are rolled down to suitable size for further manipulation throughout the plant Here are four 40-inch blooming mill stands, each pair driven by a 2,000-horse-power electric motor, and a five-stand continuous 32-inch mill driven by a 6,000-horse-power motor Beyond this are two blooming shears, 12 x 12 inches and 10 x 10 inches. Next the blooms go to a 24-inch 6-stand continuous mill, driven by a 6,000-horse-power motor, or to a pair of cooling beds for shipment If further reduction is desired the billet is sent to a 6-stand 18 inch continuous mill and rolled down to sizes varying from 3½ inches square to 1¾ inches square

LARGEST RAIL MILL IN THE WORLD

The Gary plant contains the largest rail mill in existence It is also the only electrically driven mill which rolls rails direct from the ingot without reheating. The proportions are immense, the main building being 990 feet long by 76 feet wide, with another building containing the soaking pits, for both rail mill and billet mill which is 1,350 feet long by 84 feet wide The soaking pits are square chambers with hydraulically operated sliding doors in the roof, capable each of holding four 4-ton ingots They are heated by gas and in them the ingot is brought up to the proper temperature for rolling The roll trains are driven by six 6,600-volt induction motors, three of 6 000-horse-power and three of 2,000-horse-power The finished rails are taken to inspection beds in a finishing department and are then loaded on the cars. This rail mill can turn out 4,000 tons of 80-pound rails in twenty-four hours.

GAS-ENGINE-OPERATED BLOWER PLANT

Air blast for the furnaces is produced in two buildings, 550 and 600 feet long and 104 feet wide, which are among the most interesting features of the Gary plant. The blowers, of which there are twenty in all, are driven by sixteen gas engines and four steam engines. These blowing engines are of great size and power. The gas and blowing cylinders are placed in tandem. The gas cylinders are 42 inches in diameter and the blowing cylinder 72 inches, and they have a common stroke of 54 inches. Each gagine is of 2,000 horse-power and runs at a speed of 60 revolutions per minute, and each delivers 23,000 cubic feet of free air per minute at a normal pressure of 18 pounds per square inch. The gas engines were built by the Allis-Chalmers Company and the Westinghouse Machine Company. When the plant of sixteen furnaces is completed there will be no less than thirty-two of these engines with a total horse-power of 64,000

GAS-DRIVEN ELECTRIC POWER PLANT

The most interesting feature of the whole establishment at Gary is the huge power house, 105 feet wide and 956 feet long, which provides the electric current for one-half of the complete plant. It is the largest gas-power plant in the world and contains seventeen horizontal twin-tandem double-acting Allis-Chalmers gas engines of 3,500 horse-power, each directly connected to a 2,500-kilowatt generator, fifteen of which are 6,600-volt alternating-current machines and the other two 250-volt direct-current machines. These huge engines are the largest ever constructed for the use of blast furnace gas. Their cylinders are 44 inches in diameter by 54 inches stroke Each twin unit carries on a 30-inch shaft a 23-foot 100-ton fly-wheel. The plant also contains two Curtis steam turbine generators for starting and for auxiliary service in case of necessity Additional gas-electric engines will be provided in two separate buildings, aggregating 60,000 horse-power Thus the ultimate capacity of the electric power plant will be 120,000 horse-power

Limitations of space prevent any more detailed description of the many features of interest which are found at Gary The combined steel plant and city of Gary are the most noticeable instance in America of the rapidity with which a large area of apparently valueless land may, at comparatively short notice, be transformed into a huge center of industrial activity Not only is about one-half of the plant in operation, but the adjoining city already has a population of 15,000 souls. Four years ago the site was a wind-blown waste of sand on the shores of Lake Michigan

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THE HANDLING AND STORAGE OF OUR HUGE GRAIN CROP

(*Continued from page 445*)

els per hour to cars or boats. It has a rated storage capacity of 2 500,000 bushels, and it may be mentioned here that the elevators of the Armour Company alone are capable of storing 13 500 000 bushels a day This elevator is constructed entirely of wood, and the square bins which range in size from 500 to 7,000 bushels capacity, are built of spruce planks, 2 x 4 inches at the top of the bin and 2 x 10 inches at the bottom laid lengthwise upon each other, and each spiked to the layer below The whole interior of the main body of the building is built up of a perfect honeycomb of these bins. The bottoms are tapered and finished in spouts to insure a free delivery of the grain in unloading

The more modern elevators, such, for instance, as those designed by the Metcalf Company and shown in our illustrations, are built of reinforced concrete, the bins being circular in form, are of great strength, and of thoroughly fireproof construction. The square tower-like building contains the elevating, cleaning, weighing, and conveying machinery At about the middle height of this building horizontal covered passageways serve to contain conveyer belts, by which the cleaned and weighed grain is transferred to the top of the bins and loaded into the particular bin desired.

The annual shipment of grain to Europe is about 150,000,000 bushels, and as our five thousand bushels from the Dakota farm are destined to cross the ocean, we will trace its course from the Chicago elevator in which it is reposing to its final stowage in the hold of an ocean cargo steamer. At the end of its railway journey to Chicago, the grain passes through similar experiences to those it

(*Continued on page 455.*)

THE SOUTHWEST LIMITED TO EXCELSIOR SPRINGS

TAKE THE SOUTHWEST LIMITED to Excelsior Springs, Missouri, and enjoy a visit there now—the most delightful season of the year.

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In these days, when history is making so rapidly as to call for daily and even hourly editions of newspapers, and science is advancing at such a pace that new periodicals are constantly cropping up to announce developments in specialized branches the mere task of collecting this mass of material condensing it classifying it sifting out the errors and finally putting it in such a form as to be of value as a record for the well informed man is in itself stupendous but it is disheartening to know as all makers of encyclopedias do know that the very day after publication the work is beginning to grow old and out of date The mass of information which is contained between the covers of an encyclopedia is living material matter that is as alive as the age in which we live Hence it is inconstant Part of it is aging and dying *much of it is* developing and expanding and is giving birth to new ideas and the effort to keep all this material in alphabetical order and keep it abreast of the times has always been a serious problem which the publication of annual volumes has not solved for the reason that the additional matter published contains only the new facts while leaving the old and worn out ideas in the original encyclopedia where they are liable to mislead the reader A new departure in this line has just been made in the Nelson Loose Leaf Encyclopedia which is so arranged that any facts which may become out of date can be taken out of the very heart of the volume and replaced with new material without in the least affecting the alphabetical order or destroying the arrangement as a book of ready reference The loose leaf binding is ingeniously contrived to give the volume the appearance of being permanently bound Nelson's Encyclopedia was first prepared in permanent binding in 1907 When a year later the loose-leaf edition was published it was found necessary to make 800 changes in order to bring the encyclopedia up to date A large staff of editors is employed to keep the present encyclopedia up to the hour and from time to time new leaves are issued and sent *to the subscribers furnishing them* with authoritative information on current topics and informing them where to insert the matter in the encyclopedia As an illustration of the up to dateness of this system a set of leaves was issued last month on the death of Governor Johnson and on the Cook Peary controversy These leaves are temporary and in March of each year a complete set of leaves of about 500 will be sent to each subscriber to add to his encyclopedia and to replace matter that is out of date Formerly a man could obtain better information on the occurrences of the previous decade than those of the current year With the advent of Nelson's Encyclopedia such is no longer the case The subjects covered in this work are many probably a greater variety than is to be found in any other encyclopedia of the same number of volumes The articles are therefore short and concise The aim of the encyclopedia appears to be to provide general information and to avoid technical language as far as possible to furnish not merely a record of events but to give instructions wherever possible that will be of practical value to the reader Take for example the entry Cycle Not only is a brief history of the bicycle given but also instructions to the prospective buyer of a wheel which will enable him to choose the best machine and hints on the care of a wheel This strikes us as a rather unique feature but one that will doubtless be appreciated by many subscribers to this work The articles are a trifle more brief than one would like to have them but they are accompanied by carefully selected bibliographies for those who desire to study the subject further The encyclopedia appears to be an exceptionally good gazetteer containing many geographical names that do not appear in other works of this kind A pronouncing dictionary is placed at the end of each volume so that if a person is in doubt as to the pronunciation of a certain word he can look it up very quickly and without having to wade through the body of the book where his attention is liable to be diverted by the many interesting subjects which the volume contains

Wild Flowers and Trees of Colorado By Francis Ramaley Ph D Boulder Colo University Book Store 1909 8vo 78 pp

This little volume is intended as an introduction to Colorado plants It is not a result of book study but of many summers work on Alpine heights and on the plains It will prove of interest to all students of botany particularly if they live in the State of Colorado

Tables and Other Data for Engineers and Other Business Men By Charles B Ferris B S Knoxville Tenn Published by the University Press. Price 50 cents

(Continued from page 451.)

had at the receiving house. It is discharged into the boot, carried up the leg, and spouted into the bins. This time, however, instead of one leg, there may be from sixteen to twenty, and the four bins will have increased to over one hundred. Our five thousand bushels of grain then are discharged by gravity from the bottom of the bin to the boot of an elevator, are lifted and discharged again into a big spout, through which they flow directly down into the hold of a lake cargo vessel moored alongside the elevator.

This vessel is of a special type which has been developed for the lake trade. Although she may be capable of carrying over ten thousand tons of cargo, she is nothing more nor less than a huge barge with straight parallel sides, blunt of bow and stern, with accommodations for the seamen at the bow, and with engine boilers and captain's accommodations at the stern. The main body of the ship consists of one vast hold, access to which is gained by a long line of hatches. Our 5,000 bushels of grain together with hundreds of thousands of bushels that may have been gathered from half a dozen different centers in the wheat-growing districts of the West, now start on their long journey at ten or twelve knots an hour to Buffalo, being consigned to one of the great waterside elevators in that city. The vessel is moored alongside the elevator, with its hatches opposite a huge tower-like structure built against its side and extending a story higher than the rest of the building. Inside of the tower and swinging from a hinge at its top is a huge steel-and-timber structure, which is nothing more nor less than our old friend the belt elevator grown to Brobdingnagian proportions. Almost before the ship is alongside and the hatch covers are off, this swinging elevator is moved until its boot hangs directly over the opening into the hold. The boot is extended until it enters the hold and is buried deep in the mass of grain. The elevator leg is some 90 feet in length, and it can be raised or lowered some 50 feet if necessary. In a single hour it can lift 15,000 bushels out of the hold and into the elevator.

As the grain reaches the head of the tower leg, it is shot directly into a receiving bin. Beneath this bin is a weighing scale with a hopper of 200 bushels capacity. The scales are set for a certain weight, and the weighing hopper is filled by pulling a lever which moves a slide in the bottom of the receiving bin above. The man who does the weighing is so expert that he can fill the scale hopper with the exact amount, no more nor less, once in every fifty seconds, which he must needs do when the huge marine leg is pumping grain out of the hold at the rate of 15,000 bushels per hour. From the weighing hopper the grain is delivered direct to the storage bin, or if, like our 5,000 bushels, it be destined for transportation across the sea, it will be carried across the building and out again as fast as the railway cars can be found to accommodate it. The cars will carry the grain direct to one of the great grain-exporting seaports, Portland, Boston, Newport News, or New York.

The method of operation at the seaport elevators is similar to that of the Chicago warehouse. The main difference is that, whereas at Chicago the barge steamer lay against the side of the elevator and the grain was delivered directly to the hold through the spout below the open door, it will frequently happen that the grain must be carried several hundred feet out over a pier and there discharged into the hold of the ocean-going steamship. This is done by means of a belt conveyer.

Now, this is not by any means the first time that our consignment of grain has made its acquaintance with the belt conveyer, which has been aptly described as the elevator leg belt stripped of its metal cups and lying upon its side. The belt conveyer is extensively used in the vari

(Concluded on page 471.)

Chicago & North Western Ry.

NEW PASSENGER TERMINAL, CHICAGO—Madison Street Entrance

THE PORTAL OF THE WEST

THE New Passenger Terminal of the Chicago and North Western Railway at Chicago is to be one of the finest monuments ever erected to the commercial life and spirit of the West.

It is to be located between Canal and Clinton Streets, extending from the main entrance fronting on Madison Street, over Washington and Randolph Streets to Lake Street.

More than $20,000,000 is to be expended to provide a railway entrance to the city through which passenger traffic to and from the territory that has made Chicago powerful and rich is to move in ceaseless activity.

Work upon the new station is proceeding with all the rapidity that skill and liberal expenditure can command.

The new station will have a capacity for handling a quarter-million patrons daily.

It is confidently asserted that its provisions for doing this expeditiously and with the greatest comfort will excel anything ever known to the traveling public.

Almost 10,000 miles of railway are included in the marvelous system of the North Western Line. It reaches 2,000 active Western cities, towns and villages included in nine Western States, which are thus placed in immediate and vital touch with Chicago, the Great Central Market.

By traffic arrangements with its connecting lines practically every point west and northwest of Chicago is placed in direct touch with the city, by through passenger train service, and freight shipments are handled with precision and dispatch, consigned through to any one of 9,500 stations, located on 62,000 miles of railway, about one-eighth of the entire railway mileage of the whole world and one-fourth of the railway mileage of the United States.

The North Western Line is the pioneer line west and northwest of Chicago and the Only Double Track Railway between Chicago and the Missouri River. Its service includes

THE BEST OF EVERYTHING

THE NORTH WESTERN LINE

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W. B. KNISKERN,

Passenger Traffic Manager, Chicago, Ill.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

WAIST AND SKIRT SUPPORTER.—A. M. PRESTON, Broxton, Ga. The objects here are: to provide a supporter which is at once simple in construction, durable and certain in operation; to provide a device which will lie closely and snugly to the form, and to provide a device which is neat and presentable in appearance.

SELF SUPPORTING STOCKING.—G. GRAHAM, New York, N. Y. The invention relates more particularly to the means employed for supporting a stocking. The upper portion of the stocking is so formed that it in itself constitutes a garter, so that no separate supporting means need be employed. The invention covers any fabric foot covering, as for instance, socks, hose, half hose, etc.

Electrical Devices.

TROLLEY POLE CATCHER.—J. H. WALKER, Lexington, Ky. The purpose in this case is to provide a construction in connection with the pole and a lower connection, whereby the pole may be prevented from rising to a perpendicular position when the trolley wheel jumps the wire, and whereby the pole may be held in any intermediate position and may be permitted to freely move in contact with the wire in the operation.

Of Interest to Farmers.

JOURNAL FOR AGRICULTURAL IMPLEMENTS.—A. C. DITMAR, Davenport, Wash. An efficient journal is provided which can be attached to a plow beam or the like for the purpose of revolubly mounting a coller disk or other part, in which the disk can be set at any angle, which will fit any kind of plow, in which the spindle is in a dust-proof boxing and in which the wearing parts are supplied with lubricant.

ANIMAL COVER.—C. L. HASTINGS, Fond du Lac, Wis. The aim in this invention is to provide a durable cover which is particularly useful for cattle, by means of which the animal can be well covered when necessary, which thoroughly envelops the body, leaving the head, neck and legs free, and in which means are provided to prevent the displacement of the blanket from the rear of the body.

Machines and Mechanical Devices.

FILLING DEVICE.—J. PAPISH, 608 Freeman Street, Valparaiso, Ind. The aim is to provide in this invention a device by means of which powders, crystals or other granular material can be expeditiously and easily introduced into small-necked bottles and the like, which requires little effort to operate it, and which fills the receptacles without spilling any of the material which is being introduced into the receptacle.

Railways and Their Accessories.

DOOR.—C. H. WHITMAN, Watervliet, N. Y. This improvement in doors is especially designed to be used in connection with street railway cars, and has for its purpose to automatically register the number of passengers entering and which will permit of the exit without operating the registering mechanism. The movements of the motorman on the platform will not be more restricted than when the usual type of door is employed.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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AND EACH BEARING THAT DATE

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ous inland and Great Lake grain warehouses for transporting the grain horizontally from one part of the warehouse to the other Thus, when the wheat is shoveled out of the railway car into a spout below the open door, it will frequently happen that the transfer takes place at some distance from the particular one of the twenty elevator legs by which the grain is to be lifted to the top of the bin In this case it will be allowed to fall through onto a broad traveling belt of the kind shown in our illustration, upon which it will move swiftly until it reaches the spot at which it is to be delivered or "tripped." Here the belt will pass over a set of pulleys arranged above one another in such a way that the grain can be shot off the belt for such further handling as may be desired In this particular case it will be delivered to the boot of the elevator, carried up, and discharged to its own particular bin

Time saving is a great consideration in these huge warehouses, and one of the most interesting features is the system of swinging distributing spouts, intervening between the receiving and weighing bins at the head of the elevators and the huge honeycomb of storage bins below One of our views shows these spouts, hinged below the floor of the top story of the building and capable of being swung around and over the top of the particular bin to which the grain is to be delivered This arrangement is one of many ingenious arrangements by which the enormous mass and weight of grain can be received, weighed, placed in its own particular bin drawn away therefrom, lifted, transported horizontally and finally delivered to car or steamship in the least possible time, with unfailing accuracy, and at the minimum of cost

In the above description we have traced the grain from a farm in the Middle West to the hold of the steamship that would carry it to Europe. As regards the general system of receiving, selling, and distributing the grain, the same methods apply to the wheat which is consigned to the great flour mills, say, of Minneapolis, or to any of the centers in which it is prepared for the consumption of the masses.

* * *

CHICAGO AND THE RAILROAD SYSTEM OF THE MIDDLE WEST

(Continued from page 447)

000 passenger station, that will be ready for occupation early in 1910 With one exception it will be the largest passenger terminal in the United States. Over thirteen acres of ground will be occupied by the station and station tracks The approaches cover thirty additional acres, fifteen acres being used for the north and the west approaches. The present station, with capacity for handling fifty thousand passengers per day, is now overtaxed, the new terminal will be capable of taking care of a quarter of a million people every twenty four hours.

The plans call for an elevated terminal, reached by two elevated approaches of four tracks each, and a train shed 800 feet long and 320 feet wide, that will contain sixteen tracks, each with a capacity of fifteen cars. The area of the basement is over two acres, the street floor of the station building covers one and three-quarters acres, the train shed, six acres. Altogether there will be practically ten acres of floor space devoted to public use. One of the most important features is the treatment of the train shed This structure will not have the usual long black expanse of sooty roof that offends the eye. The sixteen long tracks which will occupy the shed will be covered by what is known as the "Bush roof," in which the curve of the roof over each pair of tracks is broken by a concrete slot or duct, running the length of each track, and so placed that the locomotive funnels will discharge through it into the open air.

The electrification of Chicago steam railways inside of the city limits is at

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Do You Deliver Goods?

"Built for Business"

We have not found a business in which the Rapid Commercial Power Wagon does not save money compared with the cost of delivering with horses.

Giving satisfactory service in 52 different lines of business. Saving money for their owners every day

Rapid Commercial Power Wagons

If you deliver goods in any shape or form, it is not a question of whether or not a Rapid Commercial Power Wagon will save you money—it is simply a question of which kind of a "Rapid" will best fit your business.

Write us the nature of your business. State how many wagons or trucks you now use and how many men are required on each, and our Traffic expert will send you an accurate analysis showing the comparative cost and the definite saving, between doing business the modern "Rapid" way and with the use of horses.

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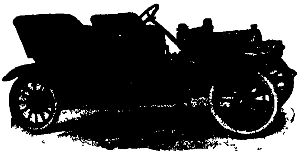
Before You Buy Any Other Car



There are five models to select from, ranging from $900 to $1700.

Model 36, for five passengers, at $1275, is shown above.

It has a straight line body with a square front dash (very popular in the best 1910 Models).

A wheel base of 110 inches.

A tonneau that appears to have been made for a seven-passenger instead of a five-passenger car

Twenty-eight to thirty actual horse-power

Full elliptic springs in rear with semi-elliptic in front, giving to the Car an element of ease rarely found in any but the highest-priced cars.

A positive self-starting device that is added to the regular equipment at slight additional cost.

Full equipment.

For good roads or bad roads, for hills or sand, or big loads, the Lambert Friction-Drive operates with less annoyance, takes hold better and is far less liable to breakage than is the case with any other known form of transmission

Furthermore, the extreme simplicity of the friction-drive makes it **by odds** the most economical transmission for the motorist. Not only are there no costly gears to replace in case of "stripping," but should the friction-band become worn or injured, it can be replaced for about one-twentieth the cost of new gears.

Send for detailed information.

BUCKEYE MANUFACTURING COMPANY

1814 COLUMBUS AVENUE ANDERSON, INDIANA

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Bearing for trough conveyers etc roller H Bentley	941 972
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Bearings means for introducing balls into ball F Geschke	941 632
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Car coupling C H Tomlinson	941 905
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present a big problem to Chicago terminal lines and a popular subject with the people and the newspapers. Although an ordinance was passed by the City Council compelling Chicago railroads to provide other than steam power within two years it is frankly stated by the authors of the ordinance that they appreciate that the work cannot be done within this time but that they hope to see a start made toward electrification of Chicago terminals At present the fight is centered on the Illinois Central Railway, the trains of which run along Chicago's otherwise beautiful lake front. The smoke and noise from the frequent suburban trains on the Illinois Central at the city's front door have accentuated the popular demand for a change in motive power

It will be pertinent just here to give a few facts illustrating the magnitude of the business done by some Western roads and the punctuality with which it is carried on Subsequently to an announcement by one of the leading Eastern roads that one of its crack trains between New York and Chicago had been on time during 123 consecutive days the Burlington route drew attention to the fact that the Denver Limited ran the distance of 1,026 miles into Denver from Chicago on time for 136 consecutive days and that it was on time 531 days out of 546 days from January 1st 1908 to June 30th, 1909 That there has been a gratifying improvement in the safety of railway travel is shown by the fact that this company carried over 19 000 000 passengers during the past year and that not a single one of these was killed A similar creditable record is reported by the St Paul the Northwestern the Santa Fé, the Rock Island and the Alton roads The Burlington system alone employs 42 100 officers and men owns 1 703 locomotives and 52 403 freight cars carried during the past year 32 379 520 tons of freight and its receipts amounted to $78 600 000 an increase of about 100 per cent in ten years Another instance of the volume of business in and out of Chicago by rail is afforded by the Chicago & Alton Railway which on a mileage of 998 8 miles moved 9 668 927 tons of freight carried 3 828 056 passengers and received and forwarded at Chicago 3 749 920 tons of freight

Modern Improvements in Track and Rolling Stock The present necessarily brief survey of railroad conditions in Chicago and the Middle West would be incomplete without some reference to the really remarkable improvements which have been made during the past twenty five years both in the roadbed and in the rolling stock The pioneer roads built when capital was scarce and extended into countries in which they had to literally create the traffic from which returns upon the investment could be made, were necessarily if we may be excused the expression 'cut according to the cloth Cheap first cost' was the controlling motive of their construction and the locating engineer was told to lay out his line with as little disturbance of the surface of the ground as possible Hence he ran his survey around the hills or over them by steep grades instead of through them by cut or tunnel His line ran down into the valleys or crossed them by cheap timber trestles Wood was used in place of costly steel for the bridges over streams and rivers The ties were frequently laid directly upon the surface of the ground with practically no ballast beneath them the steel rail was of the lightest weight which could carry the engines and cars Twenty five years ago fifty tons was the average weight of the engine and twenty tons was the maximum load for a car The grades over the mountain were frequently two per cent and sometimes ran up to three per cent or over thereby greatly limiting the load which any one engine could haul over a given stretch of land

With the settlement of the country and the development of the passenger and freight traffic the various railroad com

(Continued on page 455.)

The NEW INVINCIBLE SCHACHT

Three Cars In One

NOTE THESE FOUR FEATURES:

FIRST —**Its price, only $875.** No other car on the market selling at anywhere near this price has the style, the **real automobile** appearance that this car presents. (Most cars at this price belong in the "near-car" class.)

SECOND —**As a Runabout,** it is an ideal car for the business or professional man, or the farmer who wants a light, handy car for business purposes or cross-country trips.

THIRD —**With surrey-seat attachment** it supplies a roomy four-passenger family car **with no extra cost.**

FOURTH —**With parcel delivery attachment** it becomes the handiest **general utility** car on the market, and will be a big favorite with merchants and farmers who have constant use for a car of this type.

Let us send you additional information about this excellent, **general utility** car

SCHACHT MANUFACTURING COMPANY

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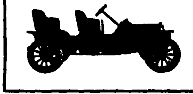

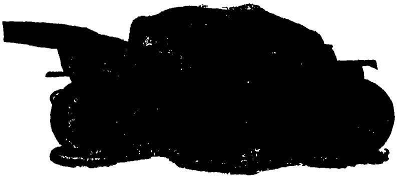

You will Buy this Haynes Model 19—$2000

If you want Known Quality Without Fancy Price

It is an innovation in automobiles.

No other manufacturer has ever attempted to give so much of real **tone** in a car selling at this price, and the payment of a **thousand dollars** more cannot buy a nicer-running engine or an easier-riding car

It is the **only** car of **established reputation** selling at a moderate price.

A ride in it will be a revelation to you —especially if you have owned other cars. Its flexibility, the power of the engine, the resiliency of the springs, the upholstering—all are of the character that you would expect **only** in cars carrying a much fancier price.

Some idea of the attitude of both automobile dealers and the public respecting a **Haynes at $2000** can be gathered from the fact that dealers bought up our entire output of 1910 cars **within thirty days** after our first public announcement, and inquiries from over six thousand interested parties have been received If you contemplate buying a car **of real worth,** we recommend that you communicate either with us or local agents **without delay.**

HAYNES

Haynes Automobile Company, 124 Main St., Kokomo, Indiana

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[illegible]	[illegible]
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Engine piston head A Starke	941,[illegible]
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Fire hose coupling H J Hickey	941,[illegible]
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Fluid pressure brake W P A MacFarlane	941,[illegible]
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Furnace grate, F Girtanner	941,[illegible]
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Gage R. Atkinson	941,[illegible]
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Gas burner J Weintz	941,[illegible]
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Gearing change speed, F D Pusch	941,[illegible]
Gearing, friction, G. H. Chisholm	941,[illegible]
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Glass, machine for making wire, J L. Arbogast	941,[illegible]
Glass, method of and apparatus for drawing continuous sheets of E. Fourcault	941,[illegible]
Glass, method of and means for manufacture of window E. L. Pring	941,[illegible]
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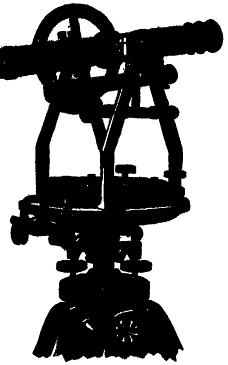

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WRITE FOR INFORMATION

(*Continued from page 454*)

panies began to find themselves in a position to bring their roadbed and rolling stock up to a higher standard, suitable to the rapidly increasing movement of freight and passengers, and during the past fifteen years hundreds of millions of dollars have been expended in this work Much of the track has been relocated, curves have been eased or eliminated altogether, grades have been cut down, timber trestles have been replaced by solid earth or rock embankments, wooden bridges have given place to massive structures of steel, heavy grades over the mountain summits have been eliminated by the simple but enormously costly process of tunneling right through the solid mountain itself, millions of tons of rock ballast have been distributed and tamped beneath the ties, and the light rails of 56 to 60 pounds weight to the yard have given place to rails weighing from 75 to 90 pounds.

Furthermore, many of the important western railroads are double-tracking their lines. The Santa Fé is building double track for its main line between Chicago and Kansas City, and beyond as far as Newton, Kansas. Between Chicago and Newton 644 miles of second track are now in operation, having been recently built at a cost of $22,500,000 Between Chicago and St. Paul and Minneapolis, the St. Paul road has been pushing to completion the double-tracking of its main line; and between Chicago and Omaha the Northwestern Railway has already completed its double track, and the Burlington road will complete the same work at an early date.

The transcontinental roads which have been built during the past few years will, of course, be spared these costly expenses for betterments. In a recent issue of the SCIENTIFIC AMERICAN SUPPLEMENT we gave a complete description of the Pacific Coast extension of the Chicago, Milwaukee & St. Paul. On the afternoon of March [illegible] of this year the last rail of this extension was laid It is now known as the Chicago Milwaukee & Puget Sound Railway The first shovelful of earth on this enterprise was turned in April 1906 so that the whole of this $100 000 000 enterprise was completed in three years time

The improvement in railway track has been fully matched by the development of the rolling stock Freight cars have increased in capacity from 20 tons to 50 tons, passenger engines have increased in weight from 50 tons to 135 tons and freight engines from 60 to 70 tons have gone up to a weight of 213 tons—the above being the weights merely of the engines alone The largest passenger engines are the magnificent six-coupled ten wheel engines used on the New York Central and allied roads and built by the American Locomotive Company They have cylinders 22 inches in diameter by 28 inches stroke coupled to three pairs of 79 inch driving wheels The boiler 6 feet in diameter has 4 195 square feet of heating surface The engine alone weighs 130 7 tons and the maximum tractive power is 16 7 tons These engines can haul as many as fourteen Pullman cars, or say about 800 tons of train on the level at 55 to 60 miles an hour

Even more striking has been the growth in weight and power of freight locomotives especially since the introduction of the articulated type The largest and most powerful of these is a mammoth affair built by the Baldwin Locomotive Works for the Mountain Division of the Southern Pacific Railway It is a compound with two high pressure cylinders 26 inches diameter by 30 inches and two low pressures 40 inches in diameter by 30 inches stroke The boiler has 6 393 square feet of heating surface The engine alone weighs 213 tons and the engine and tender together weigh just under 300 tons. This engine is capable of taking a 2 000-ton train over the heavy grades of the Mountain Division of the

(*Concluded on page [illegible]*)

American Homes and Gardens

FOR DECEMBER, 1909

Here are some of the articles it contains

MAKING SOIL

A helpful paper by E. P Powell in which he tells some of the simple methods employed by farmers in adding to the value of their soils. A practical note of unusual interest

COLONIAL FIREPLACES AND FIRE-IRONS

Mary H Northend contributes an entertaining and suggestive essay on Colonial fireplaces and fire-irons, which is richly embellished with many beautiful photographs taken expressly for this paper Miss Northend briefly traces the early history of the fireplace in America and has prepared a paper of great interest.

ART AND HOUSEHOLD DECORATION

An editorial comment on the true relationship between the home and its artistic decoration. Some useful facts put in a strong and forceful way

DEPARTMENTS

Problems in Home Furnishing. Conducted by Alice M. Kellogg.
Garden Notes. Conducted by Charles Downing Lay
New Books.
Grafting for Boys. A practical article telling how boys may engage in this interesting work and the successes some of them have attained in it.

The First Prize in the Garden Competition

The garden adjudged the first prize in the recent garden competition conducted by this magazine forms the subject of the opening article in the December number. This is a charming and delightful place abounding in picturesque developments very ably utilized and beautifully developed. The illustrations, which include several full-page plates, are very numerous and of the deepest interest

A New Artists' Home

The beautiful, yet modest, home of Mr and Mrs. Robert V. V. Sewell at Oyster Bay constitutes a notable contribution to Barr Ferree's series of papers on the homes of American artists. This house easily stands among the most notable private dwellings in America. Mr. Sewell, a painter of national renown, has lavished on his garden and his work in a remarkable embellishment of hand wood-carving, all executed by himself, which gives an intensely personal character to the house and is its distinguishing characteristic. This house has not been published heretofore.

Hammering and Piercing Metal

Mrs. Mabel T Priestman contributes a valuable and practical paper on the craft of hammering and piercing metal. This is an interesting and fascinating form of craftwork that any one, with Mrs. Priestman as a guide, can readily follow. The illustrations show clearly how this work is done, and offer many interesting practical designs.

Bungalow Furnishing

Kate Greenleaf Locke, whose article on four California bungalows is a distinguishing feature of the present number opens up a new theme in bungalow literature with an eminently readable and suggestive paper on interior bungalow detail and furnishings. Miss Locke offers a number of helpful and valuable suggestions on the treatment and equipment of bungalow interiors, and illustrates her paper with numerous and beautiful photographs taken expressly for this article.

A Concrete Fence

Ralph C. Davison's series of papers on concrete garden ornaments and how to make them is brought to a close in an interesting paper on the methods of building a concrete fence. The text is very precise and definite and is especially intended to enable any one to build his own fence from the directions given. The illustrations are especially numerous, and include both diagrams and half-tones. It is a fine article of great practical value

Some New Western Homes

Francis Durando Nichols, who has been gathering material for the magazine in the West, offers the first fruits of his work in a valuable paper on some new Western homes. The illustrations are chiefly of Chicago houses and open up an entire new school of architecture to our readers. Mr Nichols will have more to say on this subject in future numbers, but the first article should not be missed.

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(Concluded from page 455)

Southern Pacific and on the level it would be capable of hauling a train weighing 10 000 tons and carrying about 7 000 tons of freight at a speed of ten miles an hour

◆

CHICAGO'S SIXTY MILES OF FREIGHT SUBWAY

(Continued from page 448)

not even excepting New York The many trunk railroads which center in Chicago have done their best to shorten the haul to and from the freight terminals and the various business houses for if one looks at a map of Chicago it will be seen that these terminals are located in the very heart of the city and that they have reached a point beyond which because of the high value of land they cannot possibly go

The credit for the solution of the problem of freight distribution is due to Albert G Wheeler, who several years ago applied to the City Council for a franchise on behalf of the Illinois Tunnel and Telephone Company for the construction of a system of tunnels which should be used for the transmission of sounds, signals, and intelligence by means of electricity or otherwise The franchise was granted and work was commenced in a very unostentatious manner the necessary capital being found by private parties The lines as now completed extend from Armour Avenue and Archer Avenue on the south to Chicago Avenue and Kingsbury Street on the north to Green Street on the west The greater part of the sixty miles of tunnel is six feet in width and seven and a half feet in height but there are also trunk tunnels which are twelve feet in height and vary in width from ten to fourteen feet It was stipulated that the floor of the tunnel should be about forty feet below the street level and as it is generally seven and a half feet high it follows that the tunnel roof is about thirty three feet below street level By constructing the system at this depth all interference with the water and gas pipes and sewers of the city was avoided, and sufficient room was left for the construction of a complete passenger subway system between the street surface and the tunnel whenever the city should be prepared to take up such a work

It was stipulated in the franchise that the tunnel must be built below the center line of the streets and this has been done In prosecuting the work shafts were sunk as a rule in the basements of various buildings which were rented for the purpose of the tunnel company and these basements were used for mixing the concrete and for installing the air compressing plants which supplied the necessary air at ten pounds pressure for the pneumatic system under which the whole work was prosecuted From the shafts above mentioned the workmen drifted out to the center of the street where the work of excavation was carried on in opposite directions In the earlier years of construction the material was hoisted to street level loaded into contractors carts and hauled to the dumping ground on the lake front this work being done entirely in the night time to avoid any interference with the already crowded traffic of the day time In later years the dump cars have been run to the surface by means of an incline and hauled by electric locomotive to the lake front,

(Continued on page 457)

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THE AUTOMOBILE NUMBER of the SCIENTIFIC AMERICAN

On January 15, 1910, the Scientific American will issue its

ANNUAL AUTOMOBILE NUMBER

this year bigger and even better than it ever was.

It has been our purpose in publishing this annual review to give the automobile owner and the prospective purchaser truly helpful information, and to that end the number will contain the following articles:

1 *The Automobile and the Farmer*
An article that shows what the automobile can do and what it is doing for the farmer, in carrying produce to market.

2 *How to Overhaul Your Car*
An article that instructs the reader specifically how he should take down, examine and put a machine in first-class condition for a season's work.

3 *The Automobile Fire Engine.*
All the latest automobile pumping engines, chemical cars, hook and ladder trucks, and hose carts are described

4 *The Automobile and the Road.*
The automobile has presented to the road engineer new problems for solution. He must render his roads impervious to water and practically proof against the destructive effect of tires. The United States Government through the Office of Public Road Inquiry is now studying this subject. The article written by Mr Page, Director of the Office of Public Roads, describes what has been done.

5 *Anti "Joy Ride" Devices.*
This article is a complete description of devices which have been invented for the purpose of preventing chauffeurs from taking out their owners' machines.

6 *The Modern Electric Automobile*
A safe, sane, impartial account of the improvements which have been made in the electric pleasure vehicle and which are destined to stimulate the demand for an inexpensive, clean, smooth-running automobile.

7 *Making Your Own Repairs.*
In this article the handy man is told how he can circumvent the garage keeper by making his own repairs. Simple mechanical drawings elucidate the text.

8 *The Cars of 1910*
Illustrations of the chief cars of 1910, with their leading dimensions and characteristics A bird's eye view of the entire automobile field for the man about to purchase a car of any price.

9 *Automobile Identification Chart*
Sometimes you have wondered what make of car was that which skimmed past your admiring eyes. The 1910 Automobile Number will enable you to identify any car by its radiator and engine bonnet. About thirty-five automobiles are thus illustrated for identification in a sketchy, artistic way

10 *The Inexpensive Car*
Any man with a good salary can now afford to own some kind of an automobile. How the machines are constructed and what may be expected of them is lucidly set forth.

11 *The Wonderful Rise of the Automobile Industry*
How the motor-car industry grew from nothing to an industry capitalized at many millions, how the scene of its manufacturing activity has shifted from the East to the Middle West, and how the American car is gradually displacing the imported machine.

12 *Automobile Novelties.*
In this article inventions are described which increase the reliability of the automobile.

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Hose coupling expansion H C Bostian	941 355
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Packing ring piston T H. Bresnard	941,599
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Pail, dinner W A. Edwards	941,918
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Paper making machine, J A White	941,989
Paper making machine cleaning device, A T Wyant	[illegible]
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where already an addition has been made to the area of the city's park of about twenty acres. As the average fill is forty feet in depth, it can be understood that, had this enlargement been made by the city itself, it would have cost about $600,000.

The system is operated entirely by electricity, and the equipment consists at present of 175 motors of the Jeffrey and the General Electric types and 3,509 cars. There is a telephone installed on every block, and the movements of the trains are directed entirely by this means.

Although the wording of the franchise would indicate that the tunnels were to be constructed primarily for the installation of telephone and telegraph lines, it will be understood that the greatest revenue-earning power will be derived from the transportation of freight. It is estimated that about one hundred thousand tons of freight are hauled through the streets of Chicago each day, and if the tunnel company should haul only one-third of this, the total for the year would amount to over ten million tons. Hitherto no great effort has been made to push this branch of the business, but now that the system is about completed, it is expected that full connections will be made with the various business houses, and great increase in traffic will follow Connection between the various warehouses and the tunnels is made by sinking a shaft and equipping it with electric elevators, which run from the track level below to the particular floors of the warehouse upon which the freight is to be delivered In the case of a big warehouse, such as Marshall Field & Company, the loaded cars are hoisted to the desired floor, unloaded, loaded with the outgoing freight, returned to the tunnel, and drawn to the particular railroad freight station desired It will not, of course, be possible to have direct connection between warehouse and tunnel in every case, and hence central depots will be provided at various suitable locations throughout the city, so placed that the average haul by team will not amount to more than one or two blocks. One immediate advantage of the system is that the wholesale houses are now able to carry on business throughout the twenty-four hours of the day Under present conditions, after the teams have gone home for the night, the goods that are ready for shipment have to wait until the following day, and at busy seasons of the year it is not unusual for a delay of several days to occur By using the tunnel system, the merchant can make immediate shipments of his freight, whether it consists of one truckload or fifty

The tunnels will serve many useful purposes outside of that of transportation of merchandise. One of these, and a very important one, is that of the hauling away of material from the excavations for buildings within the city Hitherto, this has been done by teams upon the surface, but the present method is to run a steel chute from the excavation down to the tunnel on an angle of about forty-five degrees. The workmen wheel the material to the mouth of the chute, and dump it, and it is received and drawn away by cars, which are successively moved below the mouth of the chute in the tunnel. When a train has been made up, an electric locomotive hauls it to the dump on the lake front By this method as much as 2,100 cubic yards of material has been removed from the basement of a single building in one day The best that has ever been accomplished by teams in the same time is 420 cubic yards. Another important service rendered is that of bringing coal to the boiler plants of the various houses and the hauling away of ashes and other refuse.

In no direction has the tunnel proved more successful than that of the transportation of mail. A twelve by thirteen-foot subway has been constructed below the United States Post Office building, on-

(Concluded on page 458.)

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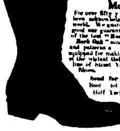

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(Concluded on page 459.)

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READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. In every case it is necessary to give the number of the inquiry. Where manufacturers do not respond promptly the inquiry may be repeated.

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Inquiry No. 8918.—For manufacturers of "Wydt's Electro Catalytic Sparking Plug."

WANTED. Machine to manufacture a special Safety Pin (all wire). I prefer to get it made by some company in quantity lots, or on royalty. For particulars, address J. H. Reed, Lancaster, Wis.

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WILL PURCHASE COMPANIES now in operation or furnish capital for promoting franchises for gas companies, trolley, water, electric light, or natural gas, patents or other good enterprises. For information, address I. L. Gallagher, Prudential Bldg., Newark, N. J.

Inquiry No. 8996.—Wanted addresses of manufacturers of machinery for working orange wood manicure sticks.

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FOR SALE. Patent No. 900,487. An improved lathe rest for holding cylinders while being bored in an engine lathe. For further particulars address A. B. Whiting, Weston, W. Va.

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Inquiry No. 9034.—For manufacturers of machinery that could reduce stumps to kindling wood.

Inquiry No. 9036. Wanted, the address of the manufacturers of "Cycle Ball Bearing Suspenders."

Inquiry No. 9038.—Wanted, the address of the Chipman Electric Purifying Co.

Inquiry No. 9042.—Wanted the address of Farney Safety Razor Co.

Inquiry No. 9044.—Wanted to buy outfits necessary for agate polishing.

Inquiry No. 9046. Wanted, machinery used for the manufacture of all kinds of fruit boxes, baskets and crates.

Inquiry No. 9047.—Wanted, the address of parties who install plants for making oxygen ozonic gas.

Inquiry No. 9048. Wanted, address of manufacturers of metal table slides for extension tables.

Inquiry No. 9049. Wanted to buy rotary brushes suitable for a shoe shining machine.

Inquiry No. 9050. Wanted to buy equipment for manufacturing starch and denatured alcohol from potatoes, also manufacturers of equipments for vegetable canneries.

Inquiry No. 9051.—Wanted to buy machinery for extraction of cotton seed oil on a small scale.

Inquiry No. 9052.—Wanted to buy machinery, etc., for a beer plant, that manufactures beer by means of glucose.

Inquiry No. 9053.—Wanted, address of firms who install plants to manufacture nitrogen.

Inquiry No. 9054.—Wanted, address of manufacturers of articles made from mica.

(*Concluded from page 457.*)

tending from Jackson Boulevard to Adams Street. The mail is thrown down chutes from the mailing platform to the platform of the subway, where the pouches are placed in the cars of the company and sent on to their destination. In the receiving of the mail at the Post Office, the pouches are unloaded from the cars onto a thirty-inch belt, which carries them up an incline to a point just below the driveway, where a cross-belt receives them and delivers them onto the mailing platform. For this work the tunnel company employs sixty-six electric motors and one hundred and fifteen cars. During the year 1907, the electric mail trains made 337,060 trips and carried 10,059,567 bags, pouches, and packages of mail, with a record of 99.51 per cent perfect as regards the time of delivery at the various tunnel stations. On the day before Christmas of that year the tunnels handled over 50,000 bags, pouches, and packages, which were transported in 1,391 cars and in 1,229 trips.

It can be readily understood that a complicated transportation system such as this, involving an enormous number of cross-overs and switches, demanded for its safe and uninterrupted operation a very complete system of signaling. The method adopted is what is known as the Stolken train-signaling system, the invention of Mr. J. J. Stolt and Mr. W. J. C. Kenyon, the vice-president of the tunnel company. Limitations of space prevent any detailed description, but in brief the system may be described as one which does not employ track circuits, but which embodies two distinctive adaptations, first, the absolute protection of an intersection of two tracks, and secondly, the maintenance of a signal or alarm for a definite time after a circuit closer has been actuated. The method is automatic. For the protection of an intersection of tracks on each of which there is traffic in only one direction, red signal lamps are employed, which are lighted by an approaching train. These lights are so placed that warning is given to a train on the other track and to any train which may be approaching from the rear. After the train has set the warning signals, it crosses the intersection, and as it passes on restores all the signals to the "clear" or no signal condition. In addition to the red lamps, a green lamp is provided on each track, which indicates to the motorman of an approaching train that his signals are working properly, and so gives him permission to go ahead.

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PENNSYLVANIA SPECIAL

is saving time and money to the business man by permitting him to snap down his desk at 4 o'clock and meet his associates in Chicago the next morning as they open theirs. In the mean time he may continue his business with a free stenographer at his elbow, or loaf with the conveniences of the club at hand.

The "Special" leaves Uptown New York at 3 55 P. M., Downtown by Ferry at 4 00 P. M., Downtown by Hudson & Manhattan Tube at 4 05 P. M., and arrives in Chicago next morning at 8 55. It kills time because it runs in the night.

"The 24-Hour St. Louis"

is giving the business man an entire afternoon for recreation at the club, or elsewhere. He may leave Uptown New York at 6 25 P. M., Downtown at 6 30 (by Ferry), Downtown at 6.35 by Hudson & Manhattan Tube and reach St. Louis at 5 25 the next afternoon. He may enjoy a good night on an easy-running train and continue his work the next day with a stenographer at his beck and call, or he may do anything he can do at his club except play billiards.

He gets a whole day in New York.

These trains are not only time-savers, but nerve-resters.

They exhilarate and refresh. They may be banked on for time.

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The Sargent Patent Cigar Chest (shown above) is a perfect little cigar store in itself. It is made of oak, mission finish, glass-lined and sanitary. No pads or sponges to bother with, the moisture being supplied by a new process. With a Sargent Cigar Chest you never lose money on dried-out cigars. The chest will be sent you with your first order and is your property even if you never buy another cigar of us.

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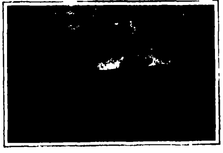

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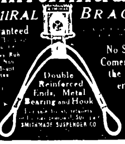

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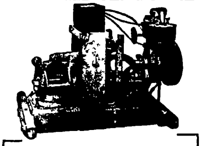

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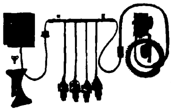

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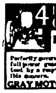

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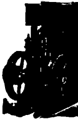

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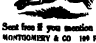

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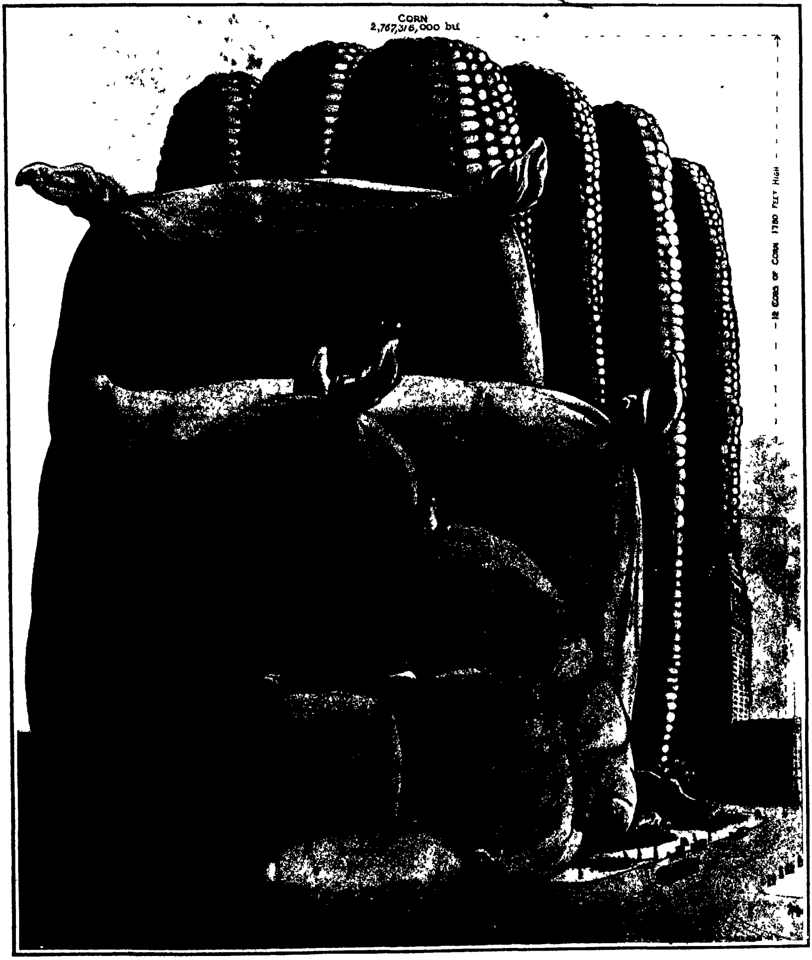
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THE ENORMOUS CROPS OF 1909.—[See page 466.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention Accepted articles will be paid for at regular space rates

A REVERSION TO TYPE

The old American eight wheel passenger locomotive, with its flexible wheel base and comparatively high center of gravity, was admirably adapted to the tracks on which it ran When, a few years ago electric traction was applied to our steam railroads, the designers of the electric motors made the mistake of ignoring altogether the steam locomotive, and basing their designs upon electric street car practice. Consequently, the first electric locomotives for this work were in respect of their driving mechanism, nothing more nor less than exaggerated trolley cars, with the characteristic rigid wheel base and a low center of gravity

When the plans of the electric locomotives for the New York Central and New Haven railroads were made public, the SCIENTIFIC AMERICAN criticised these features, and predicted that they would prove very destructive to the track particularly in their tendency to throw it out of alignment The wreck at Woodlawn, followed later by another at Greenwich established the truth of these criticisms and both locomotives have subsequently been modified, with a view to eliminating as far as possible the defects referred to

In designing the powerful electric locomotives for the Pennsylvania tunnels which are illustrated elsewhere in the present issue the defects of rigid wheel base and low center of gravity were avoided by removing the motor from the axle and placing it above the frames and by reverting to the wheel plan of the American eight wheel type, in which there are four coupled drivers and a leading four wheel truck It will be seen that if a pair of cylinders were placed above the truck, and the jack-shaft cranks and the coupling rods to the motor were replaced by a cross-head and piston, we would have the familiar steam locomotive arrangement

It will thus be seen that the locomotives are a compromise between the existing steam and electric locomotives, with the best features of each included They will combine the even turning effort and absence of unbalanced weights of the electric, with the high center of gravity and flexible wheel base of the steam locomotive Whether this is destined to be the enduring type, is a matter for the future to determine

NAVY DEPARTMENT REORGANIZATION

Since the new plan for the reorganization of the administration of the navy is described by its sponsors as 'tentative" they evidently expect that experience will suggest some modifications This being the case we have no wish to indulge in what might seem to be captious criticism for we believe that the Secretary has given his indorsement to the present plan only after a very serious consideration of its utility Furthermore, we have personal reasons for believing that many of the naval officials who have taken an active part in the recent criticisms and discussions are weary of the protracted controversy, and are anxious to welcome any plan which gives promise of harmonious and economical administration

Surely if special boards have done anything to solve the problem we ought by this time to have reached a clear road. The Sperry board, the Leutze board, and lastly the Swift board, were appointed, made their investigations, and duly reported to the Secretary The present scheme may, therefore, be taken to represent the combined wisdom of the many selected experts who have passed upon the subject.

On one point, however, we do doubt most strongly the wisdom of Secretary Meyer's proposed scheme. We refer to the proposal to take the administration of the navy yards out of the hands of the naval constructors and put the seagoing officers in control. Look at the matter whatever way we will, this move seems about as unreasonable as to take the captains and executive officers of the transatlantic liners from their ships, and place them in full control of the yards in which their ships were built. Our seagoing officers have not the experience or the special technical and mechanical knowledge to qualify them for the position of "works managers." An officer may have a perfect genius for naval strategy and tactics, he may have the most intimate knowledge of seamanship in its broadest sense, of navigation, and, in short, of everything that has to do with the management of a warship when she is in commission, and yet be a very poor mechanic, and have only a very hazy idea of shop and yard management.

If it be necessary—and we believe it is—for the present scheme of reorganization to receive the sanction of Congress, we trust that body will make a very exhaustive investigation of this phase of the question The Newberry scheme, which has now been for about a year in successful operation established the naval constructors in practical charge of the administration of the yards, subject to a commandant, it created a single payroll, and placed the care of buildings and grounds, and of all the work coming under the head of civil engineering, under a single manager The number of separate shops was greatly reduced and the officers in charge of the various shops were practically inspectors of the work done for their several bureaus. The work of the yards was greatly simplified, expenses were reduced, and there was a greater all round efficiency We trust that Congress will modify the proposals of the present scheme as far as they affect the navy yards, and permit them to be run under the present admirable plan If this modification be made, we believe that Secretary Meyer's reforms will prove to be of lasting benefit to the navy

THE VALUE OF EXHAUST STEAM.

Apart from its own inherent excellence as a prime mover the steam turbine has been teaching us many valuable lessons about the steam engine, or, to speak more correctly, has been bringing into prominence many facts regarding the steam engine which were known but whose great importance was being overlooked or neglected. We have all of us known in a general way for instance that a high pressure engine exhausting directly into the atmosphere was extravagant, but it remained for the low-pressure steam turbine to teach us how much power was being lost, and what a large proportion of that power could be recovered by expanding the steam down in a suitable auxiliary chamber It has already been established that when an exhaust steam turbine is installed as an auxiliary to a non-condensing engine, it can develop from the exhaust steam even more useful work than the engine does from the live steam. Proportionate economies also are realized where an exhaust steam turbine is interposed between the low pressure cylinder of a compound or triple-expansion engine and the condenser A notable instance of this is found in the 59th Street power station of the New York Subway, which was originally equipped with the well known Allis-Chalmers cross-compound engine

The maximum economical rated power of these engines, as contracted for, was 6,000 kilowatts, with an overload capacity of about 8000 kilowatts. At their normal rating, the engines showed a water rate of about 18 pounds of steam per kilowatt hour, and at maximum overload the consumption ran up to about 22 pounds. By interposing a low-pressure turbine between the low-pressure cylinder and the condenser it has become possible not only to run the engines with an economical water rate at their full overload, but the total kilowatt output is about doubled, the combined unit developing about 16,000 kilowatts on a water rate of 14 pounds per kilowatt hour The steam enters the high pressure cylinders at a gage pressure of from 190 to 195 pounds, the low pressure at from 45 to 48 pounds, the turbine at about one pound, and the condenser is maintained at about 28 8 inches of vacuum In the expansion from 195 pounds gage to atmospheric pressure 8000 horsepower is developed, and by the interposition of the steam turbine another 8000 horse-power is recovered between the atmospheric pressure and 28.8 inches of vacuum. This is a wonderful advance in steam-engine practice, but that we are still far removed from theoretical perfection is proved by the fact that, even with this successful combination, 60 per cent of the heat units is being carried away by the condenser water into the North River

A STEAM-TURBINE ELECTRIC LOCOMOTIVE.

Considerable interest has been aroused in British railroad circles by the announcement that the foremost locomotive construction company have perfected a new type of railroad engine, particulars of which were recently given to a Scottish university engineering society by the [illegible] of the company in question. It is described as a "steam-turbine electric locomotive," and as a turbo-electric combination. The first engine of this type, which is approaching completion in the company's shops, possesses many new and ingenious features.

In general design the engine will not differ very materially from the ordinary locomotive now in use. Steam is raised in a boiler of the usual locomotive type, fitted with a superheater, the supplies of water being drawn from tanks disposed on either side of the boiler, and the coal is carried in side bunkers. The steam is led from the boiler to a high-speed impulse turbine running at 3000 revolutions per minute, to which is directly coupled a continuous-current, variable-voltage dynamo. With this generator electrical energy ranging from 200 to 600 volts is supplied to four series-wound traction motors, the armatures of which are built on the four main or driving axles of the locomotive.

The exhaust steam from the turbine is passed into an ejector condenser, and is finally, with the circulating condensing water, discharged into the hot well. Owing to the steam turbine requiring no internal lubrication, the water of condensation is free from oil, and can consequently be discharged from the hot well direct into the boiler by means of a feed pump. In this manner the water can be used over and over again, and the water carried in the supply tanks actually serves as circulating water in the condensing operations. Circulation is effected in a closed cycle by means of small centrifugal pumps, driven by auxiliary steam turbines, placed alongside the main turbine and dynamo The water thus flows from the tanks through the first pump, by means of which it is forced through the condenser, where it serves to condense the exhaust steam from the turbine, then to the hot well, from which it is pumped to a cooler at the front of the engine, where it comes into contact with a blast of cold air caused by the movement of the locomotive and a fan which serves to cool it, and then it returns to the tank for further use

In so cooling the water, however, the usual exhaust blast which induces the draft through the furnace and boiler tubes is lost. To remedy this deficiency a forced draft is supplied by means of a small turbine-driven fan, placed within the radiator or cooler, so that while it serves to cool the circulating water it also induces a blast of hot air to the fire The cab of the locomotive carries a small switchboard, on which are mounted the controller for grouping the four motors, according to what draw bar pull is required in series or parallel, as well as the regulator for controlling the electrical circuit voltage, and consequently the speed of the train.

The whole of this main and auxiliary machinery is mounted upon a strong underframe, carried on two eight wheeled compound bogies, to facilitate negotiation of curves at high speed. Each bogie carries two of the four driving motors, as already mentioned. It will thus be seen that in reality an articulated system is adopted

The first engine to be built on these lines is approaching completion, and its performances are awaited with great interest. The experiments which have already been made by the company upon an extensive scale lead them to believe that such a locomotive as this would possess great possibilities and offer a complete solution to the traction question of to-day In any large well-equipped locomotive establishment an engine can be produced for a low figure in comparison with the electric locomotive, and by the adoption of the new combination they do not anticipate that the prime cost will be very appreciably enhanced.

* * *

The Transvaal government have set aside a fairly large sum for the erection of an experimental scrap iron smelting works. Possibly, says Engineering, the movement may eventually extend so that larger works may be built to deal with the native ore. This ore has already been employed with good results in the manufacture of different articles. Speaking of Pretoria ore, the foreman of the railroad workshops says that it is easily fluxed and good iron obtained free of sulphur and phosphorus. A test of local hematite was recently carried out and 633 pounds of iron was obtained from 1,100 pounds of ore used. The Transvaal mines' consumption of iron and steel is estimated at 50,000 tons yearly, valued at £900,000; of this £600,000 consists of rails, sleepers, pipes and pipe fittings, rock drills, and spares. The railroad also purchases about 22,000 tons of rails and sleepers annually. There is therefore scope for the opening of works, but the government mining engineer considers that the provision of blast furnaces must be a matter for private enterprise. Perhaps some day South Africa may take its place among the great manufacturing countries of the world, but that state of affairs is a long way off at present, and for many years that country will have to depend on its gold and diamonds, and in a lesser degree on its agricultural productions.

[illegible] is designed to [illegible] Rail[illegible]

[illegible] under the East River to [illegible] City, has been practically [illegible]

[illegible] of the Panama Canal have been opened [illegible]. This includes the channel from the [illegible] to the Bay of Panama, where the water is forty-five feet deep at mean tide, to the wharves at Balboa. Steamships are using this part of the canal daily.

The number of railway accidents during the year ending June 30th, 1909, was 66,711, or 2,791 killed, and [illegible] injured. This is a decrease in the total number of 4,942, or 978 killed and 5,069 injured, as compared with the number reported in the previous year. Even the reduced figures do not speak very well for the safety on our railroads.

The great railway bridge across the Sioule gorge in France was opened a short time ago. The height of the bridge is 450 feet above the ground. The bridge consists of a continuous girder 40 feet deep, divided into three spans by two intermediate masonry piers 270 feet high. The main span is 470 feet long, and each of the outer spans has a length of 330 feet.

The Public Service Commission has just issued a synopsis of the report of the Interborough Rapid Transit Company, including both the Subway and Elevated divisions, for the year ended June 30th, 1909. The subway carried 237,451,171 passengers at a total expense of $4,347,620—something less than two cents a passenger. The elevated division carried 275,737,974 passengers. The operating expenses on the subway were $4,457,630, and on the elevated $6,199,822.

Arrangements are being made to consider proposals for a fast passenger and mail steamship and train service from London to Australia and New Zealand by way of Canada, and an 18-knot service on the Pacific. The subsidy aid which would have to be given by British colonial governments would be very heavy. The Australian government demurred at first, but has finally agreed to share in the cost, and a conference will meet in London early in the spring to consider the details and apportion the cost.

A new steamship service will shortly be established between New York and Washington, and freight steamships will be in operation by the first of next year. It is estimated that the journey from New York to Washington will take from thirty-six to thirty-eight hours, including stops. A daily service of passenger steamers is in contemplation. The Potomac River serves an immense territory on either side, which is now largely without modern facilities for traveling or sending goods to market. Wharves are being built, and small steamboats will pick up the freight and carry it to the landings of the large steamships. The country on each side of the Potomac is very fertile, the eastern shore of Maryland produced 4,000,000 barrels of potatoes last year. The great difficulty has been to get the produce to market.

The following notes concerning the storage of California or crude oil in concrete reservoirs were recently given in Concrete. A 1,000,000-barrel reservoir, lined with concrete, has recently been completed at Port Richmond, Cal., and one of 800,000-barrel capacity is under construction near Bakersfield. The practice is to excavate the earth, which in most fields is a sandy loam, porous and very dry, to about one-third the depth of the proposed reservoir. With the material removed, a levee is built round the excavation, having side slopes of 1 : 1½ on both faces. The bottom and sides are then covered with about 3-inch concrete, often reinforced with expanded metal or some equivalent. Small cracks that occur at the junction of the sides and bottom and along the line between the cut and the embankment soon become filled with sediment and are believed to permit the leakage of very little oil. A number of such structures in southern California have recently been examined, and no signs of depreciation in the quality of the concrete were found.

The recent deplorable mine accident at Cherry, Ill., in which there were hundreds of deaths, brings up the question of expert direction in such disasters. [illegible] are entirely useless, as was [illegible] in France a couple of years ago, when [illegible] went down in a mine to [illegible] from the West[illegible] by the Kaiser, with their [illegible] too late, but their [illegible] been called in [illegible] number. The [illegible] would not be very [illegible] our coasts [illegible] to protect our [illegible] would be [illegible] the mine [illegible] the necessary [illegible]

SCIENCE.

Dr. Percival Lowell is installing a 12-inch telescope on San Francisco Peak at an altitude of 12,000 feet. Prof. V M. Slipher will have charge of the task of erecting the big telescope.

The discovery of a new Alhambra at Ronda, south Spain, by Lawrence Perin of Baltimore is reported. Mr. Perin recently purchased the well known Casa del Rey Moro, and proceeded to make excavations. He found large numbers of Roman and Arabian gold coins and revealed vast galleries.

The Italian Parliament will soon be called upon to provide for a special department to unroll and decipher papyri discovered at Herculaneum. It is trusted that this action may be taken immediately. Some previous documents have been damaged irrevocably because of legislative delay and neglect.

The American Museum of Natural History is to use designs of the famous Mitla ruins of Mexico for the new restaurant which is now being planned. The Mitla ruins were built of adobe and stone ornamented with mural painting and mosaic work produced by stones set in cement. The restaurant will therefore serve the purpose of an exhibition hall.

Some time ago it was ascertained that radium emanations were absorbed by the surface of lungs and intestines, but not by the skin, at least under ordinary conditions. The greater part of the absorbed emanation is quickly eliminated by the lungs, a small part passes away with fecal matter, and finally some has been found in the liver and the bile, but none is ejected with the urine or perspiration.

An international conference is proposed for the preservation of the fur seal and all marine mammals, including whales, walruses, sea lions, and sea elephants. Some of these animals are now all but extinct, and the government considers it time to formulate an international law for their preservation. The Japanese seem to be the chief offenders, for they have even ventured within the three-mile limit to carry on their work of destruction.

In a new process of keeping eggs in cold storage, 500 eggs are packed in a tin box, and a little calcium chloride is added, to insure dryness. A lid, having a hole 1/5-inch diameter, is then soldered on and the box, with a number of others, is placed in a large iron cylinder, from which the air is then exhausted. By this operation the air and carbon dioxide dissolved in the albumen are removed, as well as the air which surrounds the eggs and fills their voids. The cylinder is next filled with pure carbon dioxide, and a pressure slightly above that of the atmosphere is maintained until the constancy of the manometer indicates that the eggs are saturated with the gas. But as eggs do not keep well in pure carbon dioxide, a certain quantity of this gas is next withdrawn from the cylinder and replaced by nitrogen, obtained either from the cylinders in which it is sold in a compressed state or by passing air over red-hot copper. When the eggs have become saturated with the mixture of gases, the boxes are removed from the cylinder, sealed, and placed in rooms where the temperature is kept between 32 and 36 deg. F. By this process the eggs are kept in an atmosphere which contains no free oxygen, and in which the proportions of carbon dioxide and nitrogen are the same as exist in the albumen of fresh laid eggs.

Whether or not there is a planet beyond Neptune is a problem which has long concerned mathematical astronomers. Among those who have taken the trouble mathematically to settle the problem of such a planet's existence is Prof. W. H. Pickering, who used the method of Leverrier, the discoverer of Uranus. Prof. Pickering believes in the existence of at least one such planet, which he has designated by the letter *O*. A search for this planet was recently undertaken by the Rev. J. H. Metcalf with his 12-inch doublet, but without success. The reasons adduced in Science by Prof. Pickering for this failure are the following: (*a*) The planet may be unexpectedly faint, or reddish in color. Its computed magnitude is 13.5. (*b*) The orbit may be highly eccentric, the computation being based on an approximately circular orbit. (*c*) The orbit may be highly inclined to the ecliptic, and the planet at present situated far from its node. For various reasons the first two causes are not thought sufficiently effective to interfere with the discovery of the planet. We might, by analogy, compare planet *O*, on account of its relative size and position with regard to the other planets, to the sixth or seventh satellite of Jupiter. The inclinations of the orbits of these two bodies are 28 deg. and 28 deg., respectively. The region already covered in the photographic search extends along the ecliptic for 25 deg., and reaches to a maximum distance of 10 deg. to the north and south of it. It is expected therefore to make an examination of the higher latitudes next year. The number of stars already examined in the search is estimated at about 280,000.

AERONAUTICS.

Recognizing that all the leading European nations are rapidly developing aerial fleets of both lighter-than-air and heavier-than-air machines, Gen. James Allen, the chief signal officer of our army, made an especial plea in his annual report to the Secretary of War last week for a definite plan of aeronautical development in the army. It is to be hoped this will be given the attention it deserves. Our War Department was the first to order an aeroplane, and it should not fall behind now in aviation or aerostatics.

The second week in December is noteworthy from the fact that Maurice Farman, a brother of Henry Farman, started to make the first cross-country tour ever attempted by aeroplane. Leaving Buc, near Versailles (France), at 2 52 P. M. December 9th, he arrived at Chatres (42 miles distant) in 53 minutes, flying over Trappes and Rambouillet *en route*. His biplane, which resembles that of his brother, averaged 47 miles an hour in making this flight. The weather was fine, there being scarcely any wind. The flight formed the first stage of a trip to Bourdeaux, which M. Farman hoped to complete in four or five additional flights.

The Wright Company has recently been incorporated in New York for the manufacture of the Wright aeroplane in the United States. The company is capitalized at $1,000,000, Wilbur Wright being president and Orville Wright vice-president. Among the directors are such men as Cornelius Vanderbilt, Howard Gould, and August Belmont. The company will erect a factory at Dayton, Ohio—the home of the Wright brothers—and will also have an aviation field where purchasers can be taught the operation of the machines. It is expected that many American sportsmen will soon become interested in aviation and own aeroplanes.

On the 8th instant Earl Gray, Governor General of Canada, Lord Lacelle, and several other prominent Canadians visited Dr. A. G. Bell's laboratory at Beinn Behreagh, near Baddeck, N. S., and, in the absence of Dr. Bell, were shown about by Messrs. Baldwin and McCurdy, who are still associated with him in his experimental work. A demonstration was given of a new hydroplane boat which rose completely out of the water in a short run of a few hundred feet. It is expected to use this boat beneath an aeroplane, so as to make possible the ascent from water. Despite a hail storm and a soggy field Mr. McCurdy treated the visitors to a flight of a mile in the "Baddeck No. 2," the second biplane that he and Mr. F. W. Baldwin have constructed this year, and the one with which a considerable number of successful flights have been accomplished. Altogether, there are a half dozen different heavier-than-air machines ready to be tried out on the ice of the Bras d'Or lakes at Baddeck this winter.

The first tests in the United States of firing at balloons were carried out at the Sandy Hook proving grounds on November 27th, when a small 3-man captive balloon was anchored at a height of 300 feet and fired at from a distance of 2,000 yards. Fifteen shots were fired from a special 1-pounder having a range of movement from horizontal to vertical, without hitting the balloon. A larger field gun that could be elevated to about 40 degrees was also tried with smoke-producing shells, several of which passed over and several below the balloon. A third kind of shot was a shrapnel which exploded at a certain set distance, and discharged backward a score or more of balls in a widely expanding cone. The balloon was brought to earth by one of these shot. Before the completion of the tests, which lasted several days, 90 shots were fired with but 3 hits. Two of these were without effect. As a result of the tests, army officers believe it will be almost as difficult to hit and destroy a dirigible balloon as an aeroplane.

At the meeting of the Aeronautic Society on December 2nd, Dr. Spratt of Coatesville, Pa., an intimate friend of Mr. Octave Chanute and an aeronautic experimenter of many years' standing, gave a brief talk upon his work in connection with the aeroplane. After calling attention to the fact that all animals walk or move over the ground irrespective of the number or length of their legs, just the same as all flying creatures navigate the air no matter what the size or shape of their wings, Dr. Spratt said he believed flight depended upon a general principle as simple as that of the lever which governs walking, but that man had difficulty in discovering this principle since he was not making use of it universally, as in the latter case. Of late years he has devoted himself to finding this principle, in which quest he believes he has met with success. As a result, he has lately applied for a patent upon an aeroplane in which it is embodied. He spoke of having discovered in his early experiments the curve now used on the Wright biplane surfaces. At the suggestion of Mr. Chanute the Wrights made quantitative tests of surfaces having this curve and, finding it satisfactory, adopted it. Dr. Spratt was with the two brothers three seasons at Kitty Hawk and was an interested witness of their first flights with a motor.

THE NEW PENNSYLVANIA RAILROAD ELECTRIC LOCOMOTIVES

It is a curious instance of what might be called the vagaries of mechanical evolution that the latest and most powerful electric locomotives, of which we present illustrations should be furnished with those side rods and connecting rods, the abolition of which from the electric locomotive was considered to be one of its principal points of improvement.

Theoretically to get rid of the reciprocating movements and unbalanced rotating weights of the steam locomotive was eminently desirable for these unbalanced weights were the cause of much destructive wear upon the track and roadbed Furthermore the substitution of the compact electric motor encircling the driving axle was considered to be an ideal arrangement of compactness and efficiency

When the electric drive came to be applied to steam railroads as in the case of the electrification of the New York Central and the New Haven roads it was found that the above mentioned advantages were obtained at the expense of collateral disadvantages of a very serious character, for the low center of gravity the rigid wheel base, and the large amount of non spring supported weight combined to make the locomotives very destructive of the track Both locomotives met with serious accidents the former bursting open the track on a curve near Woodlawn and the latter doing the same thing when hauling the White Mountain express at high speed through Greenwich Connecticut The running of both types of locomotive has since been greatly improved by the substitution of four wheeled leading trucks on the New York Central locomotive and the introduction of pony trucks on the locomotives of the New Haven road.

In designing the locomotives to be used in the New York tunnel extension of the Pennsylvania Railroad, the engineers of the railroad company and of the Westinghouse Electrical Manufacturing Company have profited by the valuable experience of the past few years, and have designed an engine which will have the high center of gravity and flexibility of wheel base which characterize the steam locomotive It consists of two duplicate sections The wheel plan of each section is the same as that of the old eight wheel American steam locomotive and consists of four coupled drivers and a four wheeled truck

The sections are permanently coupled back to back by a special arrangement of Westinghouse friction draft gear and levers so that the leading section effectually pilots the rear one This obviates all necessity of turning the engine which runs equally well in either direction All manipulating levers are duplicated in each section so the operator simply changes ends.

The most original feature of this engine at least in American practice is the removal of the motors from the wheel axles and the substitution of a single motor which is placed above the frames and within the cab This motor weighs without gear 45 000 pounds and in weight and power it is the largest railway motor ever constructed At each end of the rotor shaft is a crank, the two being set as in steam locomotive practice, at ninety degrees. From these cranks a pair of coupling rods lead down to a crank-shaft (known as a jack shaft) which is carried in the frame in a horizontal line with the axles of the driving wheels. The jack shaft cranks are coupled to the drivers.

Now it will readily be seen that this arrangement avoids all the difficulties of counterbalancing which have been such a nightmare to the steam locomotive designer and to the track superintendent for since the motor crank revolves uniformly and at constant effort differing therein from steam practice the turning effort of the drive wheels is the same as for the motor and is constant throughout each revolution Moreover, it will be seen that since the movements of all rods and moving parts are those of pure rotation only, it is possible to secure perfect counterbalance, and the engine delivers no more shock to the track and roadbed than a passenger car of equal weight.

The motor and massive side frame, the jack shaft, and all other gear, are spring supported from the driver and truck wheels, so that there is no track stress other than that local to a single pair of wheels In this arrangement of motor support and connection, the center of gravity height closely approximates that in the best high-speed locomotives.

One of the 2,000 horse-power motors of the Pennsylvania electric locomotives.

A decided improvement in the 'Pennsylvania" type is the use of a single motor for two pairs of drivers and the benefits secured by its position. The motor is located high up from the roadbed secure from snow dirt and water, and its design embodies electrical features never before secured on an electric locomotive

The first twenty four locomotives to be built will have the following dimensions

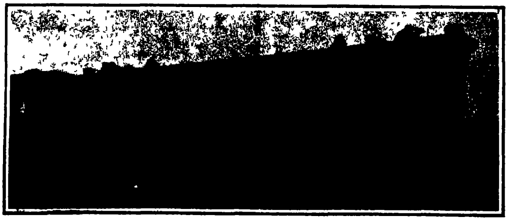
Total weight 106 tons, total horse-power 4,000 maximum draw bar pull 60 000 pounds maximum speed, 60 to 70 miles per hour under load, diameter of drive wheels 68 inches diameter of truck wheels 36 inches, weight on drivers, 104 tons, length over all 65 feet, total wheel base 56 feet.

Drive wheels, 68 inches diameter Truck wheels, 36 inches. Length over all, 65 feet.

Chassis of the new electric locomotive.

The controller on the Pennsylvania" type is scarcely as large as that on a Hoe printing press None of the main power passes through it, as it is really a switch corresponding to a telegrapher's key operated by electro-pneumatic means. With a lever which can be moved with one finger, the engineer can admit to the locomotive a current equal to that available in a hundred trolley cars

The electric supply will be secured from an electric conductor, or third rail, by four contact shoes on each locomotive At some points where the great number of track switches will not permit this power will be secured from an overhead conductor through an air-operated overhead contact shoe, of which there are two on each locomotive. The first locomotive, which is now being tested both as to speed and hauling power on the Long Island Railroad, is giving satisfactory results.



Weight, 166 tons. Horse-power, 4000 Drawbar pull, 60,000 pounds.

THE NEW PENNSYLVANIA RAILROAD ELECTRIC LOCOMOTIVE

Electric Traction in Tunis.

In the region of Tunis there has been installed an extensive system of electric traction lines. The new electric sections, which are now in regular running, are designed to replace the former steam railroad. This latter comprised three lines, one of these running from Tunis to La Goulette, about 10 miles distance, the second from the city to Marsa, 11 miles, and the third from La Goulette to Marsa, about 5 miles. The region covered by the lines is of interest as being the site of ancient Carthage and its extensive suburbs. The first two sections had a common portion of about 6 miles between Tunis and Aouina. The steam lines had been conceded in 1871 to an English company which turned them over to the Florio Rubattino company ten years later, and they afterward passed into the hands of the Bone-Guilma railroad company The government made an arrangement in 1905 with the Tunis traction company to have the lines changed to the electric system. This was carried out by the Paris Thomson Houston firm, and the government wished to profit by the jetty which had been laid across the Tunis Lake so as to use it for the line as far as La Goulette and thus run in a straight path The old traject is kept between La Goulette and Marsa, but there is also a second branch which runs nearer the sea coast, traversing the site of Carthage and reaching the elevated locality of Sidi bou Saïd, then descending to the terminus at Marsa.

The object of the new line is to enable the population of Tunis to reach the seashore easily and rapidly, and the new shore branch could not be realized by the steam road on account of the irregular ground covered here It is expected that the suburban region will be much more developed by the use of the electric line. At present the trains are made up on the multiple-unit system of two motor cars and from one to three trailers The motor cars are fitted with two motors of the G E-66 type which run on 600 volts on the overhead wire or third rail, and give 125 horse-power, using two series-parallel controllers With front and rear motorman's cabins the cars have first and second-class compartments and also a baggage or light freight compartment. The chassis has two bogies, one of which carries the motors. Current is taken by third rail for the suburban part of the line, and it is only within the city that the trolley is used The motor cars weigh 28 tons and contain 100 places, while the trailers, of an equal capacity, weigh 22 tons

The Great St. Petersburg Ozone Plant.

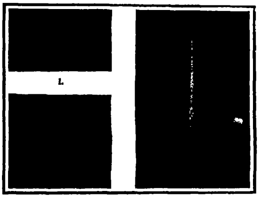
In view of the very satisfactory results obtained by the purification of the water of the Neva in ordinary sand filters, when the epidemic of cholera was prevalent in St. Petersburg about a year ago, the municipal douma and the authorities of the city have decided to erect a large plant for ozonizing water It is only just to say that the cholera infection is to be attributed in this recent outbreak to the defective nature of the actual system of distribution, which is incapable of retaining the bacteria. On the other hand, the sanitary authorities of the government, as well as those of the city of St Petersburg, are of the opinion that sterilization by ozone is the only method which is able to assure a radical purification of the drinking water of the city, their investigations, as well as those of the Institute Pasteur and Koch, having demonstrated the perfect bactericidal quality of ozone as the best means for completely destroying the microbes contained in water This large ozone plant, combined with an installation of rapid filtration (Howatson system) will be laid out according to the combined systems Siemens-de-Frise-Otto The electrical portions of the ozone apparatus will be constructed by the Siemens & Halske Company and the plant of Felten Guilleaume-Lahmeyer —La Nature.

THE LIFE OF A SPLASH.

BY PERCY COLLINS.

Probably many people have at times watched the splashes caused by rain drops falling upon the smooth surface of a pool or river. Some, too, may have gone so far as to differentiate between the splashes formed by the big drops of a thunder shower and those produced by the smaller drops of a gentle rain. In the former case a conspicuous bubble floats for a moment, and then vanishes, in the latter a crystalline fountain seems to start from a surrounding coronet of lesser jets—though this is in part an illusion, for it is known that in reality the coronet has vanished before the jet appears. The image of the coronet has not had time to fade from the eye ere that of the jet is superposed upon it. Moreover, it may have chanced to the reader to note the different effects, both of sound and of splash, produced by a stone dropped into the water—these differences apparently depending upon the height from which the stone descends, and upon the condition of its surface, i. e., whether it is smooth or rough, wet or dry. But if the reader has at one time or another made such naked-eye observations of splashes, it must be clear to him that while he has seen something, he must also have missed seeing very much more. For a splash, no matter in what way it may be produced, consists in the progress of a multitude of events, compressed within the limits of a few hundredths of a second but none the less orderly and inevitable, and of which the sequence is in part easy to anticipate and understand while in part it taxes the highest mathematical powers to elucidate.

Some fifteen years ago, Prof. A. M. Worthington, C.B., F.R.S. (Head Master of the Royal Naval Engineering College, Devonport, England), commenced a systematic study of splashes, and in order fully to appreciate the disturbance of the liquids with which he experimented and their relations he invoked the aid of photography. In these days of kinematographs and rapid snap-shot cameras, it might seem an easy matter to follow, by means of photography, even a splashing drop. But if the reader harbors this thought, he has failed to grasp the extraordinary rapidity of the movements which take place. As Prof. Worthington reminds us, the problem of how to photograph a splash is by no means a simple one, for the changes of form that take place are far too rapid to come within reach of any ordinary kinematograph, while the quickest photographic shutter is also much too slow. Thus, it became necessary to have recourse to the far shorter exposure of an electric spark. It was found that the bright spark given by breaking the primary circuit of an induction coil at the surface of mercury was of much too long duration to be useful for the purpose of flash photography, so that the originals of the photographs reproduced on this page (for which we are indebted to the courtesy of Prof. Worthington) were taken by means of a spark the duration of which was certainly less than three millionths of a second—a period of time which bears to the whole second about the same proportion as a day to a thousand years.



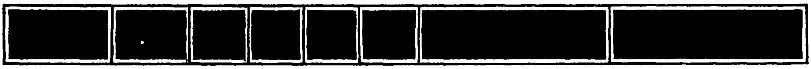
1. Primary column succeeding a drop into running water. 2. Column succeeding a drop into still water. Time 0.10 second each case. 3. Primary column caused by a rough sphere falling into liquid.

This flash is obtained by charging two Leyden jars by an electrical machine on their inner coats, one positively and one negatively. Stout wires lead from the outer coats to the dark room (where the splash is to be photographed) and terminate in a spark gap between magnesium terminals and close over the surface of water contained in a bowl. The inner coats of the Leyden jars being now connected together, the positive and negative charges unite in a dazzling flash and a simultaneous discharge and flash take place between the two outer coats across the spark gap in the dark room. This latter is the illuminating spark, by means of which the photographic exposure is to be made. The exact timing of this spark is obviously of the greatest importance. This is effected by means of a falling metal sphere which passes (outside the dark room, of course) between two terminals connected one with the inside of one Leyden jar and one with the inside of the other. These terminals are just too far apart for a spark to jump across till the timing sphere passes between them. But when this occurs the discharge takes place with the accompanying flash in the dark room. By means of an ingenious arrangement of magnets and springs (for full details of which the reader is referred to Prof. Worthington's work ("A Study of Splashes") the timing sphere can be made to fall either simultaneously with the drop or sphere destined to cause the splash to be photographed or slightly earlier or later. In this way it is possible brilliantly to illuminate the splash for one three-millionth part of a second at any desired period of its progress. For example, if a particular stage of the splash is photographed when the timing sphere falls just four feet to the gap between the terminals, then by raising its releasing lever about two-fifths of an inch the law of falling bodies insures that the flash will be postponed by just one thousandth of a second and the next photograph accordingly reveals a stage just so much later.

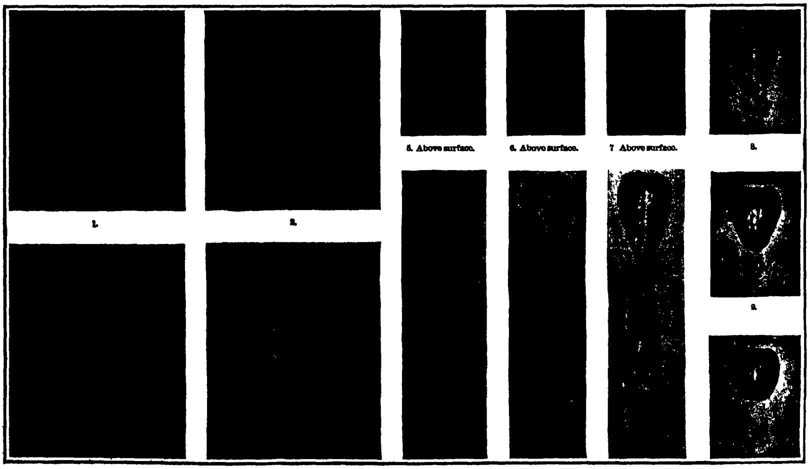
From these brief particulars the reader will be able to form an idea of the way in which Prof. Worthington's photographic studies of splashes are obtained. The camera being previously focused and arranged in the dark room, the timing sphere is minutely adjusted and released, and a record of any desired period of the splash is obtained upon the sensitized plate. Yet despite the rapidity of the plates employed and the brilliancy of the flash, the duration of the illumination is so short that the negatives are always under exposed. Hence tedious precautions have to be taken in their development.

We may now glance rapidly at a few of the many interesting facts which have been established by Prof. Worthington's study of splashes. It will probably surprise the reader to learn what a lengthy series of events follows the contact of a small drop of water, falling from a height of about 16 inches into a mixture of milk and water, the milk being added to render the photographs more intelligible. First, as the drops strikes and penetrates the surface there arises a crater, which rapidly increases in size until upon

(Continued on page 474.)


The falling drop. T=0. T=0.012. T=0.016. T=0.023. T=0.040. T=0.055. T=0.070.

The phenomena of a drop of water falling 40 centimeters into water.


1. 2. 5. Above surface. 6. Above surface. 7. Above surface. 8. 9. 3. 4. 5a. Below surface. 6a. Below surface. 7a. Below surface. 10.

THE VARIOUS STAGES OF A SPLASH PRODUCED BY A ROUGH SPHERE FALLING 800 CENTIMETERS (26.3 FEET) INTO WATER.

Prof. Jonnesco and Spinal Anæsthesia.

The visit of Prof. Thomas Jonnesco to New York has brought prominently before the public the method of producing local anæsthesia by the injection of anæsthetic solutions into the spinal canal.

Cocaine was introduced years ago as an anæsthetic for local application, it was welcomed by the medical profession, and equally by patients, on account of its invaluable services in operative procedures upon the eye, the nose, and the throat. By merely placing a drop or two of a solution of cocaine (or one of its salts) into the eye, or by painting a similar solution upon the mucous membrane of the nose or throat, it is possible to produce anæsthesia so complete as to enable surgical operations to be performed upon these parts without inflicting the least pain or discomfort upon the patients. Certain objections to the use of cocaine were not long, however, in showing themselves. Cocaine is a powerful alkaloid, and if the usual dose be exceeded, very grave results follow, a number of patients having actually died as the result of cocaine poisoning. Investigators were therefore led to search for other substances, either like cocaine occurring naturally, or prepared synthetically, which would possess the properties of cocaine while being less poisonous.

In this way, states Nature, a number of anæsthetic drugs have been introduced, including alypin, holocaine, eucaine (alpha and beta), scopolamine, novocaine, stovaine and tropacocaine. Of these the three latter have been chiefly employed in producing spinal anæsthesia. The method consists in injecting, by means of a syringe and needle, a quantity (usually about one cubic centimeter) of a solution of one of these substances into the spinal canal. The injection is made in the back, close to the middle line, the needle being inserted between two of the vertebræ. With regard to the details of the method, various procedures have been described, and no agreement has yet been reached as to which of these is to be considered the best. There is no doubt that modifications are desirable to suit particular requirements. Thus, many operators direct that the drug be dissolved in cerebro-spinal fluid or else in a saline solution having the same specific gravity and the same osmotic tension as the blood-serum Others consider that the anæsthetic solution should be considerably denser or more viscous than the cerebro-spinal fluid, and for this purpose recommend the addition of glucose or of gum-acacia to the solution These thicker solutions tend to remain at the spot at which they are injected, while solutions in cerebro-spinal fluid or in normal saline tend to spread up and down the spinal canal, and thus have a more widespread anæsthetic effect. It is usual to withdraw a few cubic centimeters of cerebro-spinal fluid from the spinal canal before injecting the anæsthetic fluid. There are two reasons for this—first, the surgeon is assured that he has actually introduced his needle into the spinal canal, and secondly he is certain to avoid increasing unduly the cerebro-spinal pressure when he introduces the anæsthetising fluid.

On introducing the fluid into a particular part of the spinal column, anæsthesia is produced of all parts of the body deriving their nerve supply from this part of the spinal cord, and all parts below If the fluid be allowed to ascend the spinal canal (e. g., by raising the hips) the anæsthesia rises higher and higher as the anæsthetic fluid reaches the trunks of the nerves arising from the higher parts of the spinal cord. If the patient be placed on one side while the injection is being performed, the anæsthetic fluid can be made to enter one lateral half of the spinal canal, and in this way it is possible to limit the anæsthesia to one lateral half of the body

The anæsthetic fluid can be allowed to ascend almost to the top of the thoracic spine without fear of untoward consequences. When it reaches the base of the neck, however, the phrenic nerve, concerned with the movements of respiration, becomes involved, and it was deemed impracticable to produce anæsthesia of the head and neck by the spinal method. Prof. Jonnesco, however, has shown that the addition of strychnine to the anæsthetic solution produces so powerful a stimulant effect upon the respiratory center in the brain that it is possible to introduce an anæsthetic fluid into the upper part of the thoracic spine, and to allow the fluid to ascend the spinal canal in the neck so as to enable operations to be performed on the neck and throat But it is as yet too early to say whether this method may be considered a safe one.

Of the three drugs which are now chiefly used for the production of spinal anæsthesia, stovaine is found to produce the most deleterious effect upon the kidneys, acute nephritis having followed its injection in quite a number of cases. Novocaine and tropacocaine are less injurious in this way, while they are equally efficacious as anæsthetics. It thus appears likely that they will supplant stovaine in the near future, and, in fact, tropacocaine in a one per cent solution is already being largely used for the purpose in this country, the usual dose injected being about 1¼ grain.

No doubt further experience will lead to modifications in the present method of performing spinal anæsthesia which will [illegible] there are [illegible] thetic is far more [illegible] surgeon than is general anæsthesia.

A SIMPLE AND EASY METHOD OF MEASURING THE HEIGHT OF AN AEROPLANE ABOVE THE GROUND.

The vertical plane in which the height of an aeroplane above the ground is to be taken, is determined beforehand and marked on the ground by two stakes sufficiently far apart and long enough to allow the two observers commissioned to take the measurement to note the precise moment when the aeroplane passes into the plane determined by the two stakes.

The base $O_1 O_2$ or line of this plane on the ground, is carefully measured and with as much precision as desired. This can be any desired length, say 500 feet. At O_1 and O_2 two observers are placed, each provided with a theodolite-like instrument, or any other apparatus used in artillery for measuring the angles α and β made by the straight lines $O_1 M$ and $O_2 M$ with the base $O_1 O_2$. This measurement must be taken simultaneously by the two operators at the precise moment the aeroplane crosses the vertical plane $O_1 A B O_2$. This much given, we purpose determining the height $m M$ or h a simple examination of the diagram shows that we can write

$$O_1 m = h \cot \alpha$$
$$O_2 m = h \cot \beta$$

Adding these two equations, member to member, we have

$$h \ (\cot \alpha + \cot \beta) = O_1 m + O_2 m = O_1 O_2$$

Whence

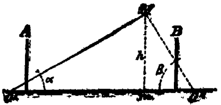
$$h = \frac{O_1 O_2}{\cot \alpha + \cot \beta}$$

If the angle measuring apparatus is graduated and gives directly the lengths of the cotangents, we shall have, supposing $\cot \alpha = a$ and $\cot \beta = b$

$$h = \frac{500}{a + b}$$

It is easy to see that with a slide rule a simple reading will immediately give the value of h.

Instruments for measuring angles α and β are so well known in artillery that it is unnecessary to refer to them; but we will remark that this method of measuring is susceptible of great precision and should give satisfaction not only to the aviators themselves but also to the official observers.



MEASURING THE HEIGHT OF AN AEROPLANE.

Although altitude trials are not made often, the writer hopes, in the near future, to make some height measurements by this method, with the help of a very ingenious apparatus that measures the angle and at the same time determines the plane.—A. Boyer-Guillon, C.E., in L'Aérophile

◆

A Novel Science Entertainment.

Mr H. Snowden Ward of Hadlow-Kent, England, is giving a new science entertainment on the plan of Prof. Pepper's and others entitled "The Marvels of Photography" After a brief explanation accompanied by a few pictures of the developing tanks, by means of one brilliant light the audience is photographed simultaneously with several cameras directed to various parts of the hall. Two very large prints are made on developing-out paper in full view of the audience.

An assistant at the same time makes natural color exposures with autochrome plates on a special subject, and also transparencies from the regular negatives of the audience. The immense paper prints of the audience are then displayed, and later the transparencies and color pictures are projected by a lantern upon a large screen. Under the auspices of the Camera Club of New York, this entertainment is to be given in this city during the winter by Mr. Ward.

◆

To Our Subscribers.

We are at the close of another year—the [illegible] of the SCIENTIFIC AMERICAN's life. Since the subscription of many a subscriber expires, it will be [illegible] to call attention to the fact that the [illegible] the paper will be discontinued if the subscription is not renewed. In order to avoid any interruption in the receipt of the paper subscriptions should be renewed before the publication of the first issue of [illegible]. To those who are not familiar with the [illegible] word may not be out of place. The [illegible] taining articles too long for insertion in the [illegible] AMERICAN, as well as translations from foreign periodicals, the information contained in which would [illegible]

[illegible] man, and no conception of [illegible] can be obtained [illegible]. We have [illegible] the [illegible] frontispiece illustration [illegible] pendous heap [illegible] they would [illegible] last crops were piled up in [illegible] the Metropolitan Tower. [illegible] and many blocks surrounding it would be [illegible] lost under the mass of [illegible].

The corn, which is the [illegible] shown, is represented as [illegible] up in pillars so as to [illegible] and though the pillar reach up to a height of [illegible] feet, this year's production of corn would [illegible] of these pillars. Next to the corn we have the production of oats, amounting to a huge total of [illegible] billion bushels. The huge [illegible] containing this quantity of oats would reach up to more than [illegible] height of the Metropolitan Tower. The wheat, which comes next in order, would require a bin [illegible] large which, even when laid on its side, would overtop the tallest structures in New York. If this wheat was distributed among the inhabitants of this country, every one, man, woman, and child, would receive over eight bushels for his share of the crop. If this quantity were taken to a flour mill, it would be converted into one and two-thirds barrels of flour, and out of this quantity of flour a baker could make nearly five hundred loaves of standard five-cent size. In other words, we grow enough wheat in this country to supply every individual with a loaf and a half of bread per day. This is slightly more than the average supply per capita for the last forty years.

Comparing our crops with other countries, we find that the United States leads the world in the production of corn, oats, and wheat. Last year [illegible] not equal European Russia's oats production, but this year's estimate is 17[illegible] bushels more than that of last year; and while the figures for the 1909 crop in Russia are not as yet available, it seems improbable that they will equal our own figures for this year. When it comes to barley, we must take second place, acceding first place to Russia. Russia also leads the world in the production of rye. We stand [illegible] in the production of potatoes, with Germany, Russia, and Austria ahead of us.

While we may flatter ourselves on our production of corn, oats, and wheat, the figures show that we do not make the best use of our acreage. The United Kingdom seems to be able to produce more wheat from an acre of land than any other country. For the years 1898 to 1907 it has produced [illegible] bushels per acre, as against 13.9 in this country and [illegible] in Russia, which makes the poorest showing of the large wheat-growing countries. Germany leads in the yield of oats with 49.3 bushels per acre against [illegible] in this country. However, it [illegible] the country having the [illegible] should have a poorer [illegible] in which farming operations [illegible] scale and more particularly [illegible] the treatment of the [illegible] product.

The crop estimate [illegible] preliminary estimate, and the [illegible] will be published [illegible] AMERICAN is on the press. The [illegible] given below, showing a large increase over last year's figures in nearly every crop.

Crop.	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

[illegible] of December 4th, page [illegible] "The Cherry Mine Disaster," [illegible]

[illegible] after the accident, the min[illegible] in some of the gal[illegible] were taken out after their [illegible] I [illegible] to the experts of the [illegible] and of the Technologic [illegible] of the United States Geological Survey, who [illegible] from the first that there were [illegible] in the mine, and that a day or two [illegible] little difference."

It was with sincere regret that I read such a statement in a journal that has large influence among the [illegible] people of the country. I fear that the statement you make will be largely believed, and that it will [illegible] injury to a movement which gives [illegible] materially in working out [illegible] of preventing mine disasters, as [illegible] aiding in the rescue work following [illegible].

[illegible] may have been the personal opinion of [illegible] mining experts at the Cherry [illegible] probability of the entombed miners being [illegible] in the mine at any time following the disaster, [illegible] such opinion was given out or in [illegible] their efforts—which were continued night and day—to reach the entombed miners, whether dead or alive. On the other hand, the mining [illegible] of the government and the members of the rescue corps were not only willing but insistent that the rescue work should go forward as rapidly as possible. Your correspondent's statement also does equal injustice to [illegible] State inspectors, who were doing everything possible to get into the mine with the [illegible] purpose in view.

As you may know, the mining engineers of the government are entirely without authority for direct [illegible] rescue work. Their official work is that of investigation as to the causes of such disasters; but they were anxious to and did aid in every possible way in the work of opening up the mine with a view to saving life.

Their use of helmets for artificial breathing while [illegible] mine gas was in several instances effective at this mine, as it has been in saving life at several other mine disasters. Such use of the oxygen helmet has on a number of occasions been of even greater service in preventing mine explosions, and extinguishing mine fires.

George Otis Smith, Director.
Washington, D. C. United States Geological Survey.

[It should be stated that our correspondent, who visited the Cherry mine, and informed himself fully in regard to the situation there, stated that experts of the [illegible] made the statement referred to. Of course, such statements were entirely informal and [illegible], and it was far from the wish of the Editor to [illegible] that any negligence on the part of [illegible] had occurred. The admirable work of the Geological Survey is too well known to require [illegible] in our columns.—Editor.]

[illegible]

[illegible] of far-reaching importance [illegible] recently delivered [illegible] House of Lords, which is the [illegible] Mr. Alexander Stanley Elmore [illegible] United States, and the company exploiting the [illegible] process for the separation of ore by [illegible] against Minerals Separation [illegible] were infringing his [illegible] patents depended upon the selective [illegible] the success of their process, but El[illegible] pure use of oil did not achieve [illegible] in the course of experiments he [illegible] that if a small quantity [illegible] the selective action [illegible] and in fact con[illegible] the success of the process. [illegible] a patent completed [illegible], however, [illegible] [illegible] distinctly [illegible] of using [illegible] per ton [illegible] only [illegible]

[illegible]

[illegible] Elmore appealed, and the lower court's findings were reversed. Minerals Separation Limited consequently carried the matter to the House of Lords, and this supreme court has now pronounced definitely against the claims of the Elmore patent.

In the course of their judgment the Lord Chancellor stated that the 1901 patent specification was framed with great subtlety, narrative and claim being so closely interwoven as to render it difficult to decide how much of the narrative ought to be read into the claims. Disentangled, however, the specification turned upon the point that Elmore claimed the sole right to add any acid to the solution. No statement is made as to the proportion of this agent, this varying according to the character of the material treated. The Lord Chancellor stated that this latter factor is so wide that it sought to cover any known process of separating mineral substances by the selective action of oil and acid, and stated that he did not consider that Elmore had really discovered the enhanced effect produced by the addition of acid. For this reason he pronounced against the 1901 patent, and decided that no infringement had been made of Elmore's patent, in which decision the four other judges unequivocally concurred. This final decision has terminated a protracted litigation, and the Elmore claim cannot now be possibly sustained.

The Scientific American Aeroplane Trophy.

When the proprietors of this journal gave into the custody of the Aero Club of America their handsome aviation trophy nearly three years ago, it was with the belief that such a cup would help to create interest in the fascinating subject of human flight and would stimulate American inventors to renew their efforts toward its solution. It was at first thought advisable to hold contests upon a given date and at a stated place, and the first such contest was to have been held at the Jamestown Exhibition on September 14th, 1907, but as there was only one uncompleted aeroplane ready at that time, and as the announcement of future competitions did not meet with any response, it was decided to change the rules so that any experimenter could try for the trophy at any place provided he gave a few days' notice to the Aero Club so that the proper officials could be present to time and observe the flight. Under the new rules Glenn H. Curtiss made the required flight of a kilometer in a straight line at Hammondsport, N Y., on July 4th, 1908, as a result of which he was declared the winner of the first leg of the trophy. Instead of requiring a specified distance for 1909, it was decided to award the trophy this year to the aviator who covered the greatest distance in excess of 25 kilometers over a closed-circuit course. On July 17th Mr Curtiss made a new record of 24.94 miles in 52½ minutes above a triangular course at Mineola, L. I. This is the present record, and is the longest flight made in America by any aeroplane except the Wright. If it remains unbroken up to sunset on December 31st, Mr Curtiss will have won the second leg of the trophy and will have to win it but one more year in order to hold it permanently.

As there are several new aviators who have been making successful though brief flights of late with their own aeroplanes, we believe that it would require but a little practise upon the part of some of these to enable them to surpass the present record. Flying an hour in December, in the vicinity of New York should be no more arduous than automobiling for a like length of time, and when the prize to be won thereby is the first, the handsomest, and the most commemorative trophy ever offered in America, it is certainly well worth the attempt. We look for some budding aviator to send in his entry during the last days of the present year.

Nobel Prizes Awarded.

This year's Nobel prizes will be distributed as follows: For physics, divided between William Marconi and Prof. Ferdinand Braun of Strasburg, for chemistry, Prof. Wilhelm Ostwald of Leipsic, for physiology or medicine, Prof. Theodor Kocher of Berne, for literature, Selma Lagerlöf, the Swedish authoress.

The Nobel prizes, which are worth about $40,000 each, are awarded annually to those persons who are considered to have conferred the greatest benefit on mankind during the preceding year in the fields specified in the cable dispatch, with the addition of one for the best effort toward the fraternity of nations and the promotion of peace.

Prof. Ferdinand Braun is Director of Physics at the University of Strasburg. He was born at Fulda, Germany, on June 6th, 1850, and was educated at the University of Berlin. From 1876 to 1882 he was professor at the University of Marburg.

Prof. Wilhelm Ostwald, who received the Nobel prize for chemistry, was born at Riga in 1853. In 1887 he became Professor of Chemistry at Leipsic. As an investigator in connection with physical chemistry and chemical affinity he has become particularly well known. His researches have concerned, among numerous subjects, the electric conductivity of organic acids, and the color of ions. He has published several volumes on this and other scientific subjects.

Prof Emil Theodor Kocher, who will receive the Nobel prize for physiology and medicine, is a Swiss surgeon. He is a native of Berne, where he was born in 1841 He was educated there, and after studying at Berlin, Paris, and London became Professor of Surgery in the university of his native city and Director of the Surgical Clinic. His especial field is the thyroid gland.

The Current Supplement.

Mr Robert M. Strong's admirable comparison of the gasoline and alcohol engines is continued in the current Supplement, No 1772 Mr Vaughan H Wilson contributes an excellent note on the future of aluminium as a substitute for copper wire. Mr George S Hodgins writes on time speed control signals, in which he explains how the New York Subway trains are automatically controlled In view of the difficulty experienced by the New Theater in New York city with its acoustics, an article by Floyd R. Watson should be of interest. The wonderful wine-growing and wine-pressing establishments of Kempinski & Co., the largest in Germany, are fully described and illustrated Our Paris correspondent writes on the new electric locomotives for the Simplon tunnel Action at a distance produced by drying oils is the title of an article by Werner Schmidt. He shows that many substances apart from radio-active substances affect the photographic plate. Among these is a class of so-called drying oils, the best known of which is linseed oil varnish. Mr William H Ballou contributes a popular article on some of the showy mushrooms in nature In view of the return of Halley's comet, Prof E. E. Barnard's contribution on photographing comets is most valuable.

Daniel's Comet.

Zaccheus Daniel of the Princeton observatory discovered a great comet on December 6 d. 599 Gr M T, in R. A, 6d 16m 30s. Dec. + 33 deg. 50 min with a slow northerly motion. At the time of its discovery the comet was visible in a small telescope.

Prof E. E. Barnard of the Yerkes observatory observed Daniel's comet December 7 d. 6606 Greenwich Mean Time, in R. A. 6h. 16m. 42s. Dec. +34 deg. 44 min 22 sec.

At Smith College observatory, Northampton, Mass., Daniel's comet was observed on December 8 d. 5870 Greenwich Mean Time, in R. A. 6h. 16m 57 6s. Dec. +35 deg 30 min 53 sec.

Metcalf reports Daniel's comet December 8th 1909, at G M. T 12h 30m., R. A. 6h 16m 52.5s. Dec. +35 deg. 27 6 min

Continued Ephemeris of Halley's Comet.

A letter has been received at Harvard Observatory from Father G M. Searle, C.S P., of New York, giving the following "Continued Ephemeris of Halley's Comet. T assumed to be Apr 19 d. 692 G M T '

Gr. Mean Noon 1910.	R. A (1910 0) h m s.	Dec. Deg. Min	Log Δ	Br (Sept 11 = 1)
January 2	2 14 37	+ 11 23 3		
January 4	2 7 50	+ 11 5 2	0 154	18
January 6	2 1 21	+ 10 47.8		
January 8	1 55 11	+ 10 31 1	0 165	18
January 10	1 49 21	+ 10 15.3		
January 12	1 43 49	+ 10 0 4	0 176	18
January 14	1 38 35	+ 9 46.4		
January 16	1 33 39	+ 9 33 4	0.188	18
January 18	1 29 00	+ 9 21.3		
January 20	1 24 38	+ 9 10.2	0 200	19
January 22	1 20 31	+ 9 0 0		
January 24	1 16 38	+ 8 50.6	0 212	19
January 26	1 12 59	+ 8 42 1		
January 28	1 9 34	+ 8 34 5	0 223	19
January 30	1 6 21	+ 8 27 6		
February 1	1 3 18	+ 8 21 6	0 234	20

Official Meteorological Summary, New York, N. Y., November, 1909.

Atmospheric pressure Highest, 30 72, lowest, 29 48, mean, 30.16 Temperature Highest, 74, date, 12th, lowest, 30, date, 25th, mean of warmest day, 62 date, 12th, coolest day, 32, date, 25th, mean of maximum for the month, 54 1, mean of minimum, 41 3, absolute mean, 47 7, normal, 43.9, excess compared with the mean of 39 years, 3.8. Warmest mean temperature of November, 50, in 1902, coldest mean, 37, in 1873 Absolute maximum and minimum of November for 39 years, 74 and 7 Average daily excess since January 1st, 1.0 Precipitation 1 58, greatest in 24 hours, 1 0 date, 24th and 25th, average for November for 39 years, 3.38. Accumulated deficiency since January 1st 4 44. Greatest precipitation, 9.82, in 1889, least 0 75, in 1903. Wind Prevailing direction northwest, total movement, 9,232 miles, average hourly velocity 12 8, maximum velocity, 48 miles per hour Weather Clear days, 11, partly cloudy, 11, cloudy 8, on which 0 01 or more of precipitation occurred 6 Snowfall 1 0 Sleet 23rd, 24th, 25th Mean temperature of the autumn, 55.50; normal 55.27 Precipitation of the autumn, 4.32, normal, 10.57

THE NINTH ANNUAL LEPINE EXHIBITION OF TOYS IN PARIS.

BY JACQUES BOYER.

This year's Lépine exhibition of toys, like that of last year, contains many toys relating to aviation. Kites of strange designs, aeroplanes, and dirigible balloons are shown in great numbers.

Richer's "Modern War" represents an attack upon an airship, which carries a target consisting of two crossed flags. The projectile, which is shown in the center part of our photograph, is a small aeroplane made of wood and celluloid. It consists of a wooden spindle with a longitudinal slot for the reception of the wings. A screw propeller is attached at the stern. The projectile is launched by means of a pistol, the barrel of which also has a longitudinal slot through which the wings of the aeroplane pass. When the target is struck the balloon separates into two parts, as shown in the illustration.

The "Roulis-Bilboc" of the same inventor is a little billiard table mounted upon a spherical joint, which allows it to be turned and tipped in every direction. By the side of the table is a vertical support, on which slide three wires terminating in hooks, from which three balls are suspended at a determined height above the table. The game is played by means of a top, the upper part of which is hollowed out to form a hemispherical cup of a diameter equal to that of the balls. The player winds the top and sets it spinning on the table, which he then moves in such a manner, by means of the lever, as to bring the top directly under one of the three suspended balls, and then tips the table so as to catch the ball in the cup and remove it from its support.

The "Avion" and the "Mechanical Birds" of Le Dantec are aeronautic novelties. The "Avion" is supported, propelled, and steered entirely by screw propellers driven by turbines. The "Avion" itself is formed of an assemblage of metal tubes which support a horizontal frame. This frame carries two horizontal propellers for support and ascension, and three vertical propellers, one for propulsion at one end of the axis of the frame and two for steering at the other end, the axes of these being at right angles to that of the large one. Above this frame is a plane surface having two circular openings immediately above the lifting propellers, and four valves in the form of rectangular doors, hinged at their front edges, which open and allow the air to pass during the ascent of the "Avion," but close as soon as it begins to fall. All of these propellers are driven by explosion turbines of a type invented by M. Uhlenhuth.

The "Fil-Vit" is a self-starting aeroplane, three forms of which are shown in one of the photographs. Part of the flight is accomplished by means of screw propellers driven by stretched rubber bands, the other part by soaring. One of the types is a Wright biplane with two propellers at the bow. It rises from the ground by its own effort, and accomplishes a flight of fifty yards. Another is a monoplane with one bow and one stern propeller, which also rises unaided and flies fifty yards. The third is a biplane with two bow propellers, which rises after running two yards on the ground and makes a flight of one hundred yards, gradually rising to a height of five yards.

Blin's "Crossing the Channel" is a simple but novel and attractive racing game. Starting from the French coast as Blériot did, the aviators, represented by little paper figures, endeavor to reach the cliffs of England. The aeroplanes are attached to elastic cords, which are stretched between pulleys on the two coasts. Each player, by turning his pulley, causes his aeroplane to advance, but also produces vibrations which frequently result in a fall into the sea, which for the sake of realism is dotted with little vessels.

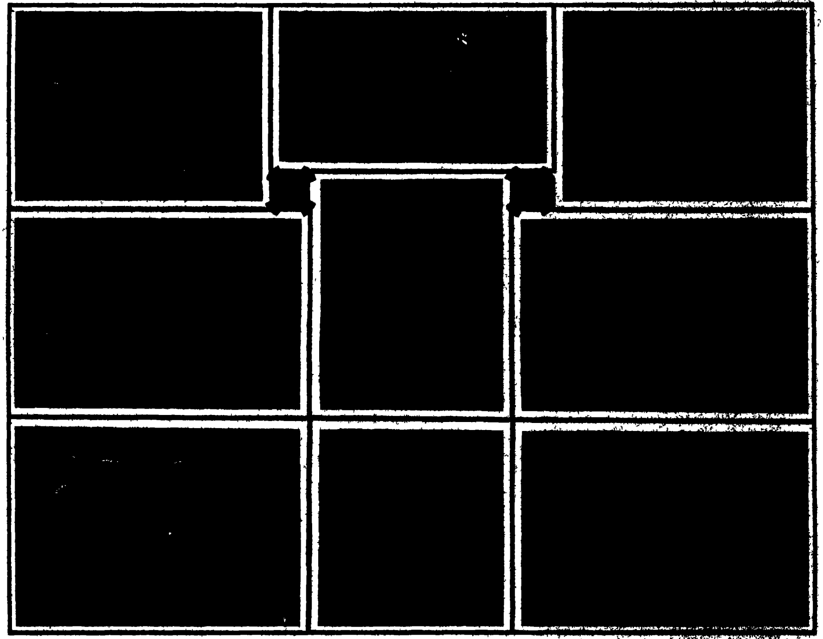
The "Aigleplan" is simply a large kite representing an eagle. The frame is formed of whalebone, steel and bamboo. The wings and head of the bird are rigid planes, and the body is represented by four rectangular pieces of very stiff canvas. The lifting power of the kite is sufficient to make it available for experiments in aerial photography and wireless telegraphy, and its constructor, M. [illegible], uses it for advertising purposes. The largest of these kites [illegible] [illegible] have [illegible] the Paris [illegible].

[illegible]'s "Whirlwind" [illegible] curved [illegible] which a car moves. [illegible] the left of Fig. (1) is a [illegible] springs, which can be depressed more or less by pulling a cord. On the platform is placed a ball, which, by operating a cord and thus tipping the platform, is caused to strike and knock down little [illegible], seated on benches around the edge.

Blin's "Polar Billiard Table" represents, in relief, the scene of the recent exploits of Cook and Peary. The North Pole is represented by a small depression. The convex polar region rests upon a square table with a raised edge. The game is played by four persons, and consists in pushing a pith ball, with the aid of a little wooden blade, up the convex surface and into the hole at the pole. The rotundity of the surface and the flatness of the blade combine to make [illegible] more difficult than it might appear.

These are some of the most [illegible] novelties to be seen at the Ninth Lépine Exhibition. [illegible] others might have been [illegible]. For example, "The [illegible]," [illegible] which is [illegible] [illegible] [illegible] activity of the [illegible] Public [illegible].

[illegible]



1. The "Mechanical Bird" and its propeller 2 The Flight Across the Channel. 3. The "Fil-Vit." 4. The North Pole Game. 5. "Modern War." 6. The "Whirlwind." 7. The "Avion." 8. The "Aigleplan." 9. The "Roulis-Bilboc."

STRIKING TOYS AT THE NINTH ANNUAL LEPINE EXHIBITION, PARIS.

CARNIVOROUS PLANTS OF THE FUTURE.

[illegible]

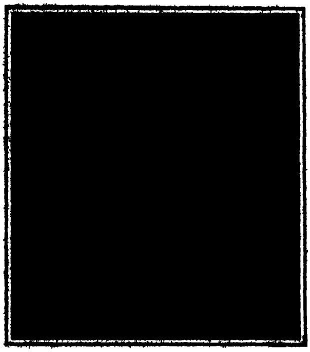
It is now admitted by scientists as beyond dispute that the carnivorous habit among plants is more widespread than it was formerly supposed to be. The specialized sundews (Droseraceae) are but the advance guard of a large army of species which depend for their existence more or less upon the absorption of animal food through their foliage. There is no gainsaying the statement, recently put forward by more than one scientist, that the tendency to rely upon a carnivorous diet is on the increase. Of course this is only in a line with the simplest evolutionary principle. It is possible to trace the steps by which the highest types of species, which seize and hold their prey, such as the Venus fly trap (Dionaea), have been evolved from those which merely capture their victims by the use of an adhesive fluid, such as the fly catcher of Portugal (Drosophyllum). Still lower in the scale are the plants, such as the teasles (Dipsacus), which drown the insects in strange bucket-like contrivances located at the base of the leaves. Flies which may chance to fall into the water are of course drowned, and the plant absorbs the nitrogenous elements from their decaying bodies.

It is a startling conception that in ages to come the plant world as a whole may become so advanced in carnivorous tastes as to be a real menace to animal creation. Dreadful indeed must be the sundews and the Dionaeas to their insect victims at the present time. The unfortunate fly which is captured by the leaf of the sundew finds itself held down by strong arms which are able to resist its violent struggles. The largest Drosera on earth at the present time produces leaves which are perhaps nine inches in length. Magnify this plant until the leaves are ten feet in length, and we have an exceedingly formidable specimen. Many of the palms and other tropical species have foliage which is much in excess of this measurement, so that the idea of leaves as big as this is not altogether fantastic. To be in proportion the tentacles could scarcely be less than ten inches in length, and these would be able to grapple with birds of considerable size. We may conceive that the giant sundew would be able to hold out some special inducement for its intended victims to visit the leaves. Probably the bait would be in the form of some sweet-tasting secretion. On alighting the birds would probably not find the adhesive fluid which the leaves would produce more than slightly annoying. The movements which they would make in an endeavor to free themselves would be all sufficient to give the stimulus to the sensitive tentacles. These would rapidly close in on their prey, and in a few moments escape would be out of the question. Finally the unfortunate birds would perish miserably, the bodies in their decay yielding to the plant the nitrogenous matter desired.

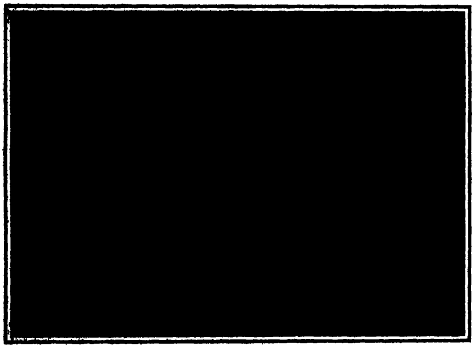
Possible enormous aristolochia flowers of the future which may lure even men

The Pinguiculas or butterworts are at the present time innocent looking plants rather attractive in appearance. These species, as is well known, find their home in boggy parts, where they spread their foliage on the surface of the ground in the form of a rosette. If the leaves of the butterwort are closely examined it will be seen that they are thickly covered with two sets of glands, one set of which is plainly visible to the naked eye. This visible set resembles a miniature mushroom, while the other set is microscopic and is formed of eight cells grouped after the manner of a wart or a knob. It is the practice of these glands whenever they come into contact with any object to pour out copiously a mucilaginous fluid, which acts much in the same way as bird lime. Acid secretion is also produced, which aids the leaf in the digestion of the object—supposing that the capture should be an insect. In order to make assurance doubly sure the

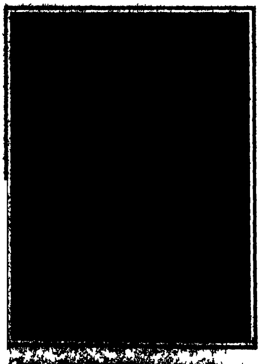
(*Continued on page 477*)



The great bladderwort swallowing a reptile.

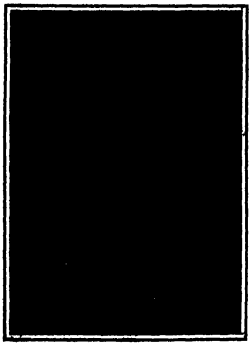


A man-eating Venus fly trap.



[illegible]

A pig-eating butterwort of the future.



A great sundew, millions of years hence, catching a stork

CARNIVOROUS PLANTS OF THE FUTURE.

THE MOST ANCIENT OF HUMAN SKELETONS.

In February, 1909, the skull of one of our most ancient known ancestors was found at Chapelle aux Saints, in the French department of Corrèze. In September a nearly complete skeleton of approximately equal antiquity was exhumed at Ferrassie, in the department of Dordogne, by Dr Capitan and M Peyrony The strata which covered the skeleton were absolutely intact and the exhumation was performed so carefully that the bones were revealed in the precise positions in which they had been laid to rest, at least 20,000 years ago. This is the first instance in which so ancient a skeleton, found in such well-marked and indisputable geological surroundings, has been photographed at the moment of exhumation and before it had been disturbed

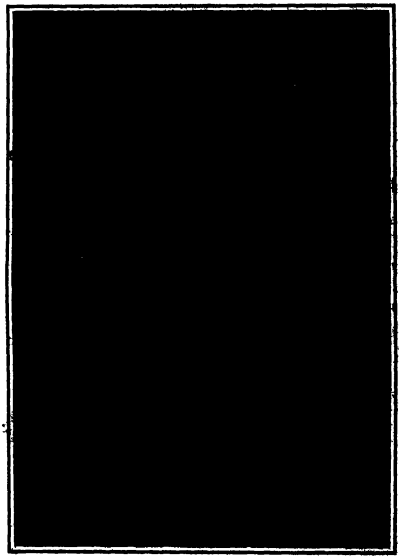
The region surrounding Ferrassie is peculiarly rich in prehistoric human remains and documents. Ten miles eastward are the famous caves of Eyzies, where the oldest known drawings on bone, ivory and horn were discovered nearly fifty years ago. In the neighboring cave of Cro Magnon Lartet and Christy, in 1858 discovered portions of five skeletons and two skulls which have recently been determined to belong to the Aurignacian race, a less ancient race than the Neanderthal to which the Corrèze skull and the Ferrassie skeleton appear to belong The same region includes the terraces of Monstier where chipped flint tools of peculiar character were found in 1863 The name monsterian has been given to the period of these tools, which succeeded the acheulean and its predecessor, the chellean, the most ancient division of the quaternary Relics of the cave dwellers have been found at various other points in the vicinity

This region has yielded, and will continue to yield, more human documents than any other part of France, for the following reasons During the monsterian period of the stone age the region was covered with prairies and forests and abounded in horses, cattle and deer, which, with the fish of the Vésère River and its tributaries, furnished a plentiful supply of food. Probably reindeer could also be found on the hills. Furthermore the river valleys are bordered by chalk cliffs and terraces, often overhanging, and honeycombed with caves, hollows and fissures, which formed excellent shelters. The deeper caves seem to have been reserved for funereal and religious uses, while savages dwelt in the shallower caves and, especially, beneath overhanging cliffs in front of which screens of boughs were constructed. A region which offered such advantages in regard to food and shelter must have been very popular in a primitive age

On the other hand it is certain that the general topography of the region has undergone little change since the monsterian period No geological convulsion has occurred The principal change is a deepening of the valley by about 30 feet, and this has further isolated the land at the base of the cliff, which was already well protected from inundation Men doubtless dwelt on the plains also in those remote times but all vestiges of them and their works have been destroyed or washed away by floods. Finally, all bodies buried in places distant from human habitations were quickly devoured by the hyenas which then abounded in France, and during the centuries that followed, the pick and the plowshare completed the destruction of the few bones that remained This is the explanation of the exceedingly rare occurrences of very ancient human bones in most regions and their comparative abundance in Dordogne.

The Ferrassie skeleton was discovered in the course of exploring a mass of debris about 100 feet long, sloping upward from the road to a low chalk cliff rising a few yards above it. The width of the mass varied from 30 to 60 feet and its height, at the cliff from 15 to 30 feet. The appearance of the superficial layer and the fissures of the cliff indicated the fall of an overhanging cliff, which should have formed an extensive shelter at a much earlier epoch As this view was confirmed by the discovery of chipped flints where the edge of the mass was cut by the road, explorations were undertaken several years ago but nothing of especial importance was unearthed until recently The excavation was begun by digging a broad trench from the road to the cliff in order to allow the mass to be removed in successive horizontal layers. Last September two bones were seen slightly projecting from the wall of the trench, near the bottom. On removing a little earth the bones were recognized as a human tibia and femur The earth over the bones was then removed, by horizontal layers, with extreme caution. When the greater part of the monsterian stratum had been removed, three flat stones, about eight inches square, covering the skull and parts of the arms, were discovered. The reddish brown sand which surrounded the skeleton contained many large splinters of bones of animals which showed marks of hammering. Very slowly and with infinite precaution the skeleton was laid bare without displacing a single bone. It lay on the back, with the trunk turned slightly to the left, and the legs sharply bent back under the thighs, which were half flexed on the pelvis. The knees were turned to the right. The left arm was extended beside the body, with the hand at the hip, while the right arm was bent, and the hand near the shoulder The head was turned to the left, with the mouth wide open.

The bones, though broken in places by the great weight of the earth above them, remained firm and in their normal positions. Only the bones of the right hand and foot had been displaced, and in part removed, probably by rodents or small carnivora.



THE MOST ANCIENT OF HUMAN SKELETONS.

The skeleton was photographed as it lay and the leg and arm bones were carefully removed. The pelvis was then covered with tinfoil and a large plaster cast was formed around it, so that it could be taken up without injury The thorax and the skull were treated in the same way Hence these parts can be mounted without the loss of a single fragment, as the earth in which they lay will surround them, inside the plaster casts, until the casts are opened in the preparing room This method is commonly employed by palæontologists, but this is its first application to human remains.

The age of the skeleton is indicated, with certainty and precision, by the regularity and very characteristic appearance of the successive strata of the mass in which it was found. (Age, in prehistoric chronology, refers, not to a definite number of years, but to a period of more or less hypothetical duration.) The quaternary geological period, in which man appeared on earth, began with the comparatively warm chellean age, which has left remains of the rhinoceros, hippopotamus, and elephant, and flint tools scarcely modified by man Then came the cold acheulean age, the age of the mammoth, marked by crudely chipped flints. The ensuing monsterian age, at first cold but subsequently mild, represents a higher civilization possessing a variety of [illegible] [illegible] [illegible] [illegible] [illegible], [illegible] [illegible] [illegible] [illegible] very characteristic of the age. [illegible] [illegible] [illegible] types were found [illegible] [illegible] [illegible] [illegible] ruder acheulean flints were found beneath it. Hence the skeleton is monsterian.

The stratum containing the skeleton was covered by two strata containing flint tools of the aurignacian age. The overhanging cliff then fell, and its debris subsequently became covered by a layer of earth and stones, five feet in depth, which has effectually protected the human relics beneath.

Dr Capitan believes that the skeleton is that of a corpse regularly prepared for sepulture, which may have been covered with earth, but was not buried in a grave. Protected by the vicinity of the living inhabitants of the shelter, the skeleton escaped the hyenas and was only nibbled by small animals. This unique skeleton, which is at least 20,000 years old, will probably be mounted and exhibited in the Museum of Natural History at Paris.

A New Substitute for Cotton.

The busy town of Chemnitz, the largest manufacturing center in the kingdom of Saxony and one of the largest factory towns of the German empire, has just witnessed the birth of a new invention which will doubtless cause considerable changes in the price of cotton and which, furthermore, will be of interest and importance to our readers in kapok-growing countries.

For some considerable time past the German textile world has been devoting unflagging attention to the discovery of fibrous plants which might in any way be rendered available as a substitute for cotton, and great interest has been given to the different more or less successful experiments made. Trials made with ramie and caravonica have been fairly successful, but have not met with that meed of success, nor attracted so much attention, which has fallen to the share of the experiments made with the fiber of the kapok tree (the so-called "silk-wool tree") which flourishes in America, Asia, and Africa. The fruit of this tree contains a seed which, like that of the cotton plant, is enveloped in soft silky hairs. These hairs, however, are so short that they have hitherto been useless to cotton spinners and have been used chiefly for upholstery and mattress-making purposes. Most kapok trees grow wild, and only recently have a few Europeans begun to cultivate them systematically in New Guinea and East Africa. Steps are also being taken to grow these trees properly in the German protectorates.

This new industry will be greatly favored by the process just discovered by a large German spinning mill, whereby it is now possible to render kapok fiber easily spinnable. So far, as an absolute matter of fact, the veritable fiber of the kapok tree has not been dealt with, but only the fibers of the Calotropis procera (a plant growing wild in East Africa); however, it is exactly the same as kapok fiber in character, appearance, and qualities. Hence, if the one can be spun, so can the other—a point on which not the slightest doubt is entertained. By means of a process evolved by Prof. Goldberg of Chemnitz, the brittle and fragile fiber of the kapok tree is treated in such a way as to render it easily spinnable, and yarn up to No. 12 English is now being spun from it. A sample, both of the raw material and of the yarn, may be seen at the offices. As will be seen, the yarn is of fine quality and of a very soft, silky, and tenacious character. The process in question does not necessitate the employment of any new machinery, but is based [illegible] upon a novel and somewhat complicated system of preliminary preparation and spinning. What the actual process is can not yet be divulged.

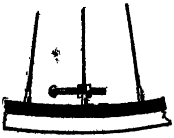
In the German African colonies fiber plants of all kinds are now being grown, and, as Dr. [illegible] recently pointed out in a report to the [illegible] Komite, the [illegible] [illegible] [illegible] [illegible] in German East Africa [illegible] [illegible] [illegible] [illegible] that in a few years time the [illegible] [illegible] will exceed 15,000 tons, and Germany will be able to meet her own requirements. [illegible] [illegible] [illegible] for the cultivation of [illegible] [illegible] [illegible] are also being laid down there. [illegible] [illegible] [illegible] [illegible]

(Concluded on page [illegible].)

IMPROVED NIPPLE GRIP.

BY THOMAS DE LOOF.

When one wishes to replace a few broken spokes in a bicycle wheel, he often finds that he has no nipple grip, while a bicycle wrench proves to be too long to get in around the spokes. A good nipple grip can be made by putting two nuts on one bolt, as shown in the accompanying engraving.



IMPROVED NIPPLE GRIP.

◆ ◆ ◆

HOW TO WATER-PROOF CLOTH.

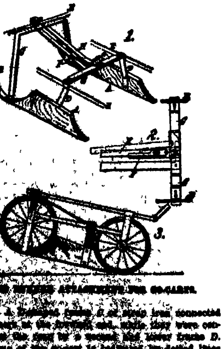
For rain coats or other water proof clothing, woolen goods having a close weave are the best. Use goods in which the face is smooth and firm, although cloth having a soft face answers fairly well, provided the weave is tight and close. To water-proof the cloth, lay it out on a large table face up. Then take a block of paraffine about six inches square and rub it all over the face of the cloth, bearing down hard This will leave a thin film of paraffine on the face of the cloth. Melt this film of paraffine into the goods, using a flat iron that is just warm. Too hot an iron will set the paraffine on fire and burn the goods. It is well to experiment with a small sample first, and learn how to do the water-proofing properly before starting in with a pattern of goods. To determine when the sample is properly water-proofed, hold it in a kind of bag, with the face in, and pour in some water If the water-proofing has been properly done the water will not wet the face of the cloth, but it will stay in globules and act as if it were on a greased board or hot stove.

◆ ◆ ◆

SLED RUNNER ATTACHMENT FOR GO-CARTS.

BY NELSON SNOKE.

The writer made a pair of runners for his go-cart last winter which proved quite a success. They were made of 1 inch by ⅛-inch iron, and weighed altogether six pounds. The construction was such that they could be applied or removed in a few seconds. Referring to the accompanying illustration, it will be seen that two wooden side pieces *A* were provided, to which the runners *B* were fastened The wooden side pieces were cut out and grooved to receive the wheels, and the runners were curved up to fit against the front wheels. A U-shaped frame, *C*, of [illegible] iron, connected the runners at the forward end, while they were connected at the rear by a second and lower frame *D*. The frame of the go-cart is indicated by dotted lines at *E*. A pair of [illegible] members *G* were [illegible] onto the frame *D*, and attached to a lever *F* in such manner that they could be [illegible] over the [illegible]. A strap *H* extending forward to the frame *C* was formed with a hook, so that when the lever *F* is moved to extend the members *G*, the strap *H* is retracted, causing the hook to fit over the front cross piece *E* of the go-cart frame. In applying the runners to the go-cart, it is merely necessary to raise the front wheels so as to clear the side pieces *A*, and then move the cart into position, after which the lever *F* is moved to lock the runners fast. One of the advantages of this system is that the runners at the rear are so short that when the cart is tilted backward the wheels rest on the ground, and in that position they can be wheeled over any bare spots.



SLED RUNNER ATTACHMENT FOR GO-CARTS.

◆ ◆ ◆

A SNOW-BOUND SANTA CLAUS.

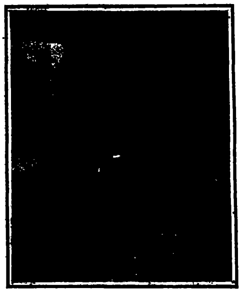
BY JOHN A. BERGSTROM

The accompanying illustrations show how a very pretty effect may be obtained in Christmas tree decoration. It has the appearance of a Christmas tree in a snow storm

Stretch a cord above and in front of the Christmas tree with one end fastened to a hook or a nail and the other end to the armature of an electric bell. Hang from this cord a number of fine threads to which at intervals small pieces of cotton are fastened The bell is connected up to a battery with a push button in the circuit. When this button is pushed causing the armature and cord to vibrate, the quivering bits of cotton look like falling snow The armature of the bell should be bent back a little so as not to strike the bell, which may be covered up with a wreath or other decoration

Fig 1 illustrates how the cotton may be attached to the threads.

A frame is first made a little longer than the curtain. This may be made out of any kind of rough lumber and nailed together At one end of the frame two rows of pins are put, about ⅛ inch apart The pins in each row should be about ⅛ inch apart At the other end of the frame is put another row of pins ⅛ inch apart.

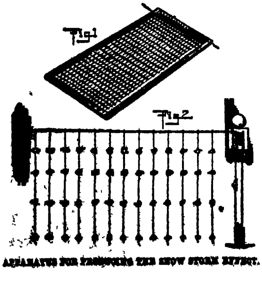


SANTA CLAUS IN A SNOW STORM.

Now wind the cord around the two rows of pins and fasten the ends, as shown Then fasten the end of a fine thread to the cord at the first pin Bring the thread down to the lower end of the frame and wind around two pins, then back again and fasten to the cord. Repeat until the required number of threads are obtained. Now take a fine brush, preferably a painter s striping brush, and apply glue to the threads, crossways, about two inches apart, the whole length of the curtain.

Cut some thin cotton batting into stripe about ⅛ inch wide, and place them across the threads where the glue has been applied, pressing them down onto the threads.

When dry cut the lower ends of the threads and pull each individual string away from the rest Just enough cotton will stick to each string After all the strings have been separated remove the cord at the upper end of the frame and the curtain is ready to be hung up Fig 2 shows a part of the curtain when finished with threads about 1 inch apart.



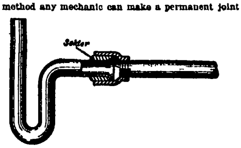
APPARATUS FOR PRODUCING THE SNOW STORM EFFECT.

◆ ◆ ◆

HOW TO MAKE LEAD PIPE INTO IRON PIPE WITHOUT A WIPED JOINT

BY HOWARD M. NICHOLS.

It takes a skilled plumber to make a lead pipe into an iron pipe, using a wiped joint but using the following method any mechanic can make a permanent joint which is equally as good as a wiped joint. The accompanying drawing shows a lead *S* made into a galvanized iron pipe The large end of a reducing coupling is placed over the end of the lead *S*, and the end is then flared out with a blunt piece of steel so that it will flare out and fit the coupling snugly, as shown The space between the lead pipe and the coupling is then filled with hot solder which is allowed to round out on the pipe and make a smooth joint. To complete the job the iron pipe is then screwed into the small end of the coupling



SIMPLE METHOD OF CONNECTING LEAD AND IRON PIPE

◆ ◆ ◆

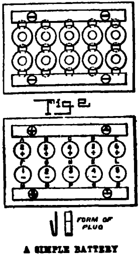
A METHOD FOR CONNECTING BATTERIES IN COMBINATIONS.

BY CHAUNCEY W NIEMAN

The inventor who deals much with electricity is bound to find himself sooner or later greatly hampered in experiments with batteries by the necessity of frequent changing from parallel to series etc It is one of the little routine details which makes most of the worry in experimenting, for the connecting up of a dozen wires may often cause the loss of a happy inspiration" A convenient and easily made switch board is illustrated herewith and it will add its mite of comfort to the harassed inventor This board for six batteries allows all possible connections, and by adding more points can be adapted to any number of batteries

It is made as follows The board' is a one-inch piece of wood mounted if desired on feet. In this bore ten holes to receive an equal number of stove bolts, as per plan in Fig 1 The bolts should be provided with large washers and the holes so bored as to allow a distance of ¼ inch between the washers when in place Next two metal strips should be fastened by two stove bolts each, one strip on either side of the rows of bolts. The distance between the strips and the edges of the washers should be ⅛ inch also At the points indicated by the dotted circles bore ⅜ inch holes half way through the board Plugs should then be made, and consist of strips of sheet copper or brass ¼ inch broad, bent as shown Wires are then led from each pole of every battery and connected underneath the board to the bolts.

The wiring diagram is given in Fig 2 Batteries are numbered from 1 to 6, and the positive and negative of each battery are connected to the bolt so marked Current is taken off at the points *X* and *Y* An understanding of the key given below will enable anyone to make the combinations indicated with great speed and almost no trouble



A SIMPLE BATTERY SWITCHBOARD

Insert plugs at	to obtain
F, *G*, *H*, *K*, and *L*	all in series
C, *F*, *G*, *K*, *L* and *P*	2 parallel sets of 3 in [illegible]
B, *D*, *F*, *H*, *L*, *N* and *Q*	3 parallel sets of 2 in [illegible]
A, *B*, *C*, *D*, *E*, *M*, *N*, *P*, *Q* and *R*	all in parallel

POWER-DRIVEN SCOOTER.

BY FREDERICK E. LOBB.

In the issue of January 9th 1909 there appeared plans for a scooter with description of how it should be built

The accompanying illustrations show how this scooter may be converted into a sort of automobile ice boat or auto scooter

The motor should be preferably an air-cooled one but as it may be difficult to get an outfit of ample power without high cost a water-cooled motor is shown in the plan as it is cheaper and there are a great variety to select from It will probably be necessary to experiment with the water system The plan contemplates a thin flat tank with a large cooling surface to act as a radiator If the weather is very cold this may be sufficient if not a simple radiator may be made by passing the water through thin copper tubing coiled in a spiral A seven horse power motor as shown weighing about one hundred and seventy five pounds and running at seven hundred revolutions, should give the scooter a speed of about thirty miles an hour on good smooth ice If a light weight air cooled motor of twenty horse-power is installed a speed of sixty miles an hour can easily be obtained

The propelling outfit may be installed in such a manner that it does not interfere with the use of the boat for sailing To do this it is only necessary to shift the gasoline tank forward and make the driving wheel case watertight the same as a centerboard trunk The steering runner could have a removable pin through the stock at the tiller head thus allowing the runner to be unshipped If the wind died out one could auto scoot home by simply putting in the rudder and starting up the motor Of course the extra weight and windage of the sails and rigging would retard the speed somewhat.

The first step in construction is to put in the trunk in which the driving wheel runs. First cut a slot in the bottom 12 inches long and 7 inches wide to allow the wheel to touch the ice The forward point of the slot is 5 feet 5 inches from the bow, if the boat is built accurately to the plans.

The old floor timber at station No. 7 will have to be cut amidships and a short one put in about two inches farther aft in order to allow sufficient space for the driving wheel

The two trunk posts are now put in These are of oak the forward one is 2½ inches wide and 3½ inches thick. It is jogged out as shown in the plan so that it rests on floor No 5 and supports the deck beam The post must be securely bolted to both floor and deck beam as a large part of the strain comes upon it The after post is 2¼ inches by 2 inches securely fastened to floor No. 7

The sides of the trunk are of white pine ⅝ inch thick and put on two pieces to a side. The joint should come in line with the wheel bearing and be cut out around it to allow play for the driving wheel as it jumps over rough ice The lower boards should land on top of the bottom and be fastened to it with brass screws put in from underneath If the posts and boards are well fitted to the bottom and set in white lead the trunk should be fairly water-tight. A removable cap of ⅝ inch white pine allows the trunk to be inspected

The wheel yoke may next be shaped out. This comprises two pieces of oak 1¼ inches thick 2 feet 3½ inches long 4½ inches wide in the middle and 3 inches at the ends with a 1⅝ x 3 inch cross piece to hold them together A 1⅝ inch hole is bored in them 1 foot 2 inches from the after end to take the flanged bearing of the driving shaft. Fig 2 shows the lay out of the yoke and trunk also the little ½ inch oak strips *AAA* which keep the yoke from chafing the sides of the trunk.

The driving wheel is of 1½-inch oak 15½ inches in diameter The rim is rounded over and fitted with twelve spikes. These can be made from 2⅝ inch iron lag screws Bore holes in the rim and screw them in Then cut their heads off with a hack saw and file them to a chisel point at an angle of about 45 degrees, as shown in the upper portion of Fig 4.

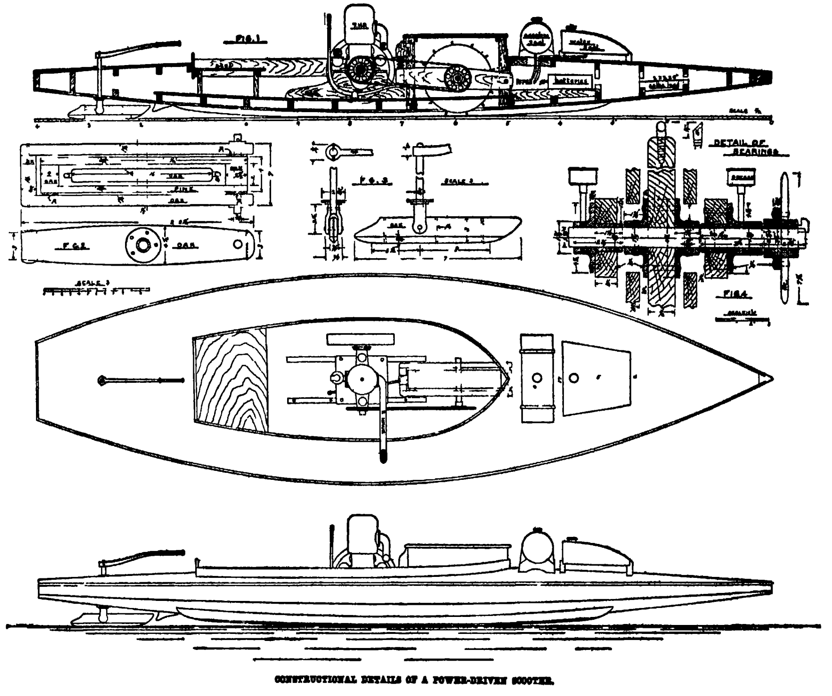
The same figure shows in detail the flanges and bearings for carrying the wheel and delivering the power The flanges should be bronze castings turned and fitted on a lathe. The cheapest way is to make one pattern large enough to enable all the flanges to be worked down from it. This would not be very expensive but the flanges must be well made or else trouble will surely ensue The driving shaft is of 1⅛ steel 14 inches long A 7/16-inch driving sprocket about 7½ inches diameter is riveted to the flange and then keyed on to the shaft. As Fig 4 shows clearly the dimensions of flanges and rivets it is not necessary to describe them in detail. The driving wheel is pinned to the shaft with two 3/16-inch taper pins driven in tightly and riveted enough to prevent working out. A couple of grease cups are put in as shown.

To put the outfit together first pin the driving wheel on the shaft and lay it in the trunk, the two upper side boards being of course removed. Fasten the two bearing flanges on the yokes and then slip each side over the shaft. The yoke is now fastened together at the rear end by two ¼-inch through bolts as shown in Fig 2 The forward end has a ⅝ inch pin passing through the oak post tightly and having two washers and pins to keep the yoke together As the thrust of the motor is taken on this pin be careful to get it to fit the wood tightly A small through rivet forward of the pin will help prevent the wood from splitting. The sprocket may now be keyed on and grease cups fitted As the driving wheel will move up and down due to bumps in the ice it must be made flexible This is accomplished by means of the movable yoke and a spring fitted at the after end of the yoke to keep it pressed down hard on the ice and prevent the teeth from slipping.

An oak block is fastened securely to the trunk post and a 3/16 inch spring about 1½ inches in diameter and 4 inches long should be about right. Drive nails in a row around the spring to keep it in place

A means must be provided for raising the driving

(Concluded on page 480.)



CONSTRUCTIONAL DETAILS OF A POWER-DRIVEN SCOOTER.

RECENTLY PATENTED INVENTIONS.

Of Interest to Farmers.

GATE AND DOOR FASTENER.—F J S. [illegible], Gonzales, Cal. In this patent the purpose of the inventor is to provide a novel, simple device for securing a door, gate, or the like in closed condition, the fastener being durable, and convenient to operate. The fastener is very desirable for use in the closure of an opening in a fence through which cattle are driven from one inclosure to another

Household Utilities.

CANDELABRUM.—O. H. VAN GUILPEN, New York, N. Y. The candelabrum is so constructed that its arms can be turned around a central support, and the arms are so jointed and connected that their members can be placed in any position in relation to each other, and fastened in adjusted position, the adjustment being done with ease at the back or front of the device.

ANTISEPTIC TOOTH BRUSH HOLDER.—W D. JONES New York, N Y The holder is arranged to contain the brush in a tube filled with antiseptic vapors, to allow convenient removal of the brush for its legitimate use and replacing of the same in the tube and to supply the latter continually with vapors to maintain the brush when not in use in an antiseptic condition.

Machines and Mechanical Devices.

MACHINE FOR SHEARING METAL SHEETS.—G B. JOHNSON, 8 Victoria Street Westminster, London, England This machine facilitates and reduces manual labor incidental to the accurate shearing of sheets to a rectangular form, and is designed to overcome difficulties in such operations when performed by a single shearing cutter to which the edges of the sheet are successively presented, and more especially when it is required to simultaneously cut a number of roofing sheets in the "pack" as the latter is delivered from the rolling mill

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THE LIFE OF A SPLASH.

(*Continued from page 465.*)

attaining its greatest proportion, its walls begin to thicken, and gradually subside to form a mere ring of lobes on the surface, surrounding a central hollow.

Then comes a rebound, manifested in the rising of a central column which, after attaining its full height and subsiding, is followed by a secondary column ere the series of events which we term "the splash" is complete. Prof Worthington shows that the separation in the form of a drop of the top of the primary column ere its complete subsidence results in a series of events markedly different from that which ensues when no separation takes place. Moreover, the manifestation of outspreading ripples is affected by the condition of the surface, and in order to secure the most favorable conditions by cleaning the surface a continous slow stream of fresh water is maintained The contamination of the surface liquid, by the way, originates in lamp black brought down by each drop, for in order to prevent the drop from adhering to the watch glass in which it rests prior to its fall, it is found necessary carefully to smoke the glass in the flame of a candle But the atoms of lamp black which adhere to and are brought down with each drop serve to make clear some important points connected with the formation of the splash. They prove by their presence that the interior of the crater is lined by the original liquid which formed the drop, and thus afford useful information as to the nature of its flow When the primary column commences its ascent, the atoms of lamp black are carried upward at its summit, proving that the liquid of the original drop emerges at the head of the central column This is confirmed by allowing a drop of milk to fall into pure water, when the photograph shows that the upper part of the column contains nearly all of the milk. This fact may be easily verified by naked-eye observation, as indicated by Prof Worthington Let the reader drop from a spoon into a cup of tea or coffee, from a height of fifteen or sixteen inches, a single drop of milk. He will have no difficulty in observing that the column which emerges carries with it the white milk-drop at the top only slightly stained by the liquid into which it has fallen

Upon increasing the height of the fall of a drop to about 40 inches a new phenomenon is registered in the photographs. The crater rises to a greater height, but instead of subsiding in the form of a ring, its mouth closes to form a bubble on the surface of the liquid. If the height be not too great, the closing is either incomplete or at any rate only temporary, and the bubble reopens at the top to make way for the column which rises as before from the base, but is now much thicker and hardly so high as before With a very high fall, however the bubble becomes too firmly closed to reopen, and its summit is struck from within by the rising column, which becomes entangled in the liquid of the bubble when the latter bursts. Thanks, however, to the influence of surface tension, regularity of form is soon regained, so that the concluding events of a splash after a high fall agree in essentials with those which follow a low fall.

The facts elucidated by experiments with a sphere dropped from varying heights into liquid proved to be of great interest and importance. Prof. Worthington suggests that those who wish fully to grasp the significance of his photographs and deductions should experiment for themselves by dropping marbles from a height of about a foot into a deep bowl of water, the bottom of which should be protected from the possibility of breakage by a few folds of fine copper gauze A perfectly clean and highly polished marble so dropped will enter the water almost noiselessly with very little disturbance of the surface In a word, the splash is singularly insignificant. Photo-

(*Continued on page 478.*)

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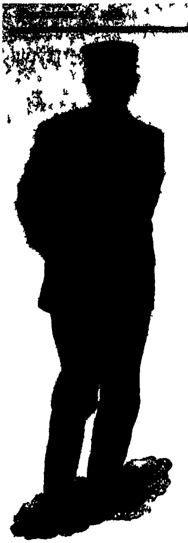

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(Continued from page 474.)

graphic records show that the liquid, instead of being driven away from the surface in the form of a crater (as is the case when a drop or a rough sphere strikes the surface) now rises in a thin, closely fitting sheath which completely envelops the sphere even before its summit has reached the water level A comparatively insignificant column constitutes the subsequent splash Moreover and as a result of the rapidly closing sheath practically no air is carried into the water by the smooth sphere This point as well as many others of great importance was shown photographically by means of illumination behind a thin glass vessel with parallel sides—an arrangement which rendered it possible to photograph the splash both above and below the surface of the fluid Most of the photographs reproduced were taken in this way

So much for the splash caused by a smooth sphere If the reader will now fish out the marble with which he is conducting his simple experiments roughen its surface with sandpaper and again drop it from a height of a foot or so into the water he will find that a totally different splash results There is now a great noise of bubbles which may be seen rising through the liquid while a tall jet is seen to be tossed into the air Photographic records of the surface disturbance closely resemble those which have already been described caused by the fall of a drop A crater is formed and subsides and a graceful jet rises from its depths gathers volume from below and rises ultimately as a tall column whose height may be even greater than that from which the sphere fell Photographs of the descent of the sphere below the surface show us how this column originates The sphere as it descends drags with it the surface film of the liquid in the form of a gradually deepening pocket or bag which ultimately forms a long cylindrical hollow This eventually divides and the lower part is dragged down by the sphere to the bottom (no matter what the depth) whence it rises to the surface as a bubble Meanwhile the upper half of the cylinder rapidly fills up and this running together of the liquid is responsible for the great velocity of the upward spurting jet or column

On increasing the height of the fall of a rough sphere a higher crater which closes and forms a bubble is obtained just as when the height of fall of a liquid drop is increased With a fall of two feet this bubble is almost immediately destroyed by an upward jet But if the height of fall be increased to four or five feet no rebounding jet will be projected into the air notwithstanding the fact that much air is still carried down by the roughened sphere To the naked eye a curious seething' appearance at the surface is apparent and Prof Worthington admits that he was at first disposed to regard this as evidence of the entanglement of the jet with the bubble—an entanglement likely to produce confused motions which could not be profitably studied However the persistence with which the seething motion again and again returned when a stone was dropped or thrown into the river led him to suspect that something required investigation The remarkable change of procedure revealed in the series of photographs which was subsequently taken will be best described by a word for word quotation from Prof Worthington's writings "The earlier figures show the very rapid rise of the crater and its closing as a bubble much before the entrapped column of air divides. Before the division takes place the liquid now flowing in from all sides closes over the upper end of the long air tube separates it from the air outside, and forms a downward jet which shoots down the middle of the air tube in pursuit of the sphere The first formation of this jet is not easy to observe because the view is obscured

(Concluded on page 477.)

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(Continued from page [illegible].)

by which successive and turbulent vortical motion resulting apparently from the [illegible] that converges from all sides of the axis of the air tube at its upper end. . . . But (when) the turbulence has cleared away from the upper part, and from this stage onward the jet is well seen in all the figures, and it persists long after the segmentation of the air column has taken place. The reader must not suppose that this jet is a mere falling of the water under the action of gravity, for the rapidity with which it advances is far greater than could be accounted for in this way. The great initial momentum of the sphere causes it to continue in rapid motion after the bubble has closed, thus the sphere acts as a sort of piston, which by increasing the length of the air tube diminishes the pressure in it and so sucks in the bubble, which is driven down by the greater atmospheric pressure above. The converging horizontal inflow near the mouth of the air tube cannot, of course, produce the downward-directed jet without an equal and *opposite* generation of momentum upward; but this is now expended, not in producing a similar upward jet, but in balancing the excess of atmospheric pressure. The reaction, in fact, to the projection of the jet downward is the force which holds up and slowly raises the roof of the long air shaft." The rising of the roof is well shown in some of the accompanying photographs.

Thus, as Prof. Worthington points out, the formation of a downward jet is not, in a sense, a new phenomenon, but one which, having existed unnoticed before, is now rendered visible by reason of its being produced in air instead of water An increase in the height of fall to 22½ feet was found to produce but little change in the phenomena coincident to the resulting splash.

As an illustration of the possible application of knowledge gained from a study of splashes in an unexpected quarter, Prof Worthington draws attention to the fact that photographs of the splash of a projectile on striking the steel armor plate of a battleship bear a close resemblance to photographs of splashes caused by a sphere falling into liquid. There is the same slight upheaval of the neighboring surface, the same crater, with the same curled lip, leading to the inference that under the immense and suddenly applied pressure the steel has behaved like a liquid. The professor suggests that from a study of the motions set up in a liquid in an analogous case, it may be possible to deduce information about the distribution of internal stress, which may apply also to a solid, and thus lead to improvements in the construction of a plate that is intended to resist penetration.

In conclusion it should be said that the number printed below each photograph here reproduced gives the time in decimal parts of a second which has elapsed since the first instant of contact.

◆

CARNIVOROUS PLANTS OF THE FUTURE.

(*Continued from page 469*)

edge of the leaf in certain species is seen to curl slowly inward Now we can imagine that in the very far-away future with which we are dealing the Pinguicula will develop leaves which will hardly be less than five or six feet in length. These lying along the surface of the ground will make a special appeal to grazing animals. Perhaps as with the sundew the allurement will be in the form of some pleasant-tasting secretion which is peculiarly attractive to sheep and goats. We can imagine how these animals at first coming across the plants would start to regale themselves at the prepared feast. The strong sticky substance would take a firm hold of the hairs surrounding the mouth parts of the creatures, and in their endeavor to free themselves the animals would become more entangled. Gradually, too, the sides

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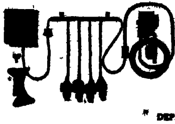

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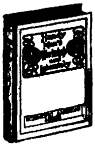

EVERY practical mechanic, whether amateur or professional has been confronted many times with unexpected situations calling for the exercise of considerable ingenuity The resourceful man who has met an issue of this sort successfully seldom, if ever, is averse to making public his methods of procedure. After all he has little to gain by keeping the matter to himself and, appreciating the advice of other practical men in the same line of work he is only too glad to contribute his own suggestions to the general fund of information

About a year ago it was decided to open a department in the Scientific American devoted to the interests of the handy man There was an almost immediate response Hundreds of valuable suggestions poured in from every part of this country and from abroad as well Not only amateur mechanics, but professional men as well were eager to recount their experiences in emergencies and offer useful bits of information, ingenious ideas, wrinkles or "kinks," as they are called Aside from these, many valuable contributions came from men in other walks of life—resourceful men, who showed their aptness at doing things about the house, in the garden, on the farm The electrician and the man in the physics and chemical laboratory furnished another tributary to the flood of ideas. Automobiles, motor cycles, motor boats and the like frequently call for a display of ingenuity among a class of men who otherwise would never touch a tool These also contributed a large share of suggestions that poured in upon us It was apparent from the outset that the Handy Man's Workshop Department in the Scientific American would be utterly inadequate for so large a volume of material, but rather than reject any really useful ideas for lack of space we have collected the worthier suggestions, which we present in the present volume They have all been classified and arranged in eight chapters, under the following headings

I, Fitting up a Workshop, II, Shop Kinks, III Soldering of Metals IV, The Handy Man in the Factory, V The Handy Man's Experimental Laboratory VI, The Handy Man's Electrical Laboratory, VII The Handy Man About the House, VIII, The Handy Sportsman, IX, Model Toy Flying Machines. Index.

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(Continued from page [illegible].)

of the huge leaves would close inward and the fate of the victim would not long be delayed. A pitiable spectacle indeed to see these animals done to death by a plant, but the same process on a smaller scale is repeated thousands of times during the summer in any place where the Pinguiculas abound.

We can hardly think in this advance of vegetable life that the many species of pitcher plants which catch their prey more by allurement than by force, would be behindhand in the forward movement. Even at the present time many of these species develop processes which are several feet in length, as exemplified in the case of the Sarracenias and Darlingtonias. In one of the accompanying illustrations is pictured one of the colossal pitchers which in the course of ages may be evolved from the comparatively small Cephalotus—a native of Australia. There is no knowing what inducements these plants might not be able to hold out for the capturing of even man himself. Perhaps the tissue inside the pitcher would be peculiarly succulent, and we know that where there is anything worth having, there will always be found men daring enough to take the risk of getting it. Once inside the pitcher of the Cephalotus, escape would be possible only with a friendly assistant at hand. From the bottom of the pitcher three barriers would confront the prisoner anxious to get out. First of all there is a circular ridge projecting in such a way that it is most difficult to surmount. Secondly a stretch of wall thickly covered with processes resembling the teeth of a comb and all pointing downward. Last of all, on the involute rim round the mouth of the pitcher is arranged a fringe of decurved spines which resemble a row of formidable bayonets. Indeed, it would be a far more simple matter to get out of the average well than to make one's escape from a giant Cephalotus pitcher.

Although the matter does not involve death, the giant Aristolochia flower brings about the imprisonment of flies for quite a long time. The system is in connection with the cross-fertilization of the blossom. The insects are induced to enter the cavernous mouth of the great bloom by an odor strongly suggestive of carrion, which is peculiarly attractive to flies. Once inside, the flies are held captive by an ingenious arrangement whereby they are lost in the tortuous passages at the rear of the flower. After blundering around for some time the winged creatures are able to emerge again, not, however, before they have become well dusted with pollen for transmission to another bloom. It is possible that the Aristolochia of years to come will assume much larger proportions, and we may imagine that the flower will be able to hold out some allurement which will tempt large animals to enter its gloomy depths. It is more likely that escape from the colossal blossom would not be such a simple matter, and there might be a danger of a creature's coming unpleasantly near to starvation before seeing daylight again.

Far more dreadful than any of the plants described above would be the Venus fly trap of the future. This plant would be a vegetable terror. As is well known, the leaves of this plant are designed in the form of a trap. On the upper surface of each half of the leaf are three hairs. To touch any of them is to cause the organ to shut up, inclosing the object which has given rise to the irritation. The bordering of the leaf is formed of sharp fringed hairs which when the trap is closed prevent escape. At the most the leaves of the Dionæa are not more than an inch in length, but we may get a little idea of what this plant may be in years to come if we imagine the foliage to be large enough to grapple with a man. It is the habit of this plant to grow with its leaves half concealed beneath the sphagnum moss in which it thrives. The leaves of the giant man trap partly hidden by the undergrowth would form the

(Concluded on page 479.)

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[illegible]

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[illegible]	[illegible]

(Concluded from page 478.)

more terrible pitfall than the world has ever seen. Any unfortunate man who should chance to stumble into one of these leaves would be speedily crushed to death by the steady pressure of the inclosing sides. One can imagine that a country in which the man trap abounded would be avoided as much as a district inhabited by man-eating savages.

The aquatic plants such as the bladderworts (Utricularia) would scarcely be behindhand in this forward movement among the carnivorous species. These plants capture small water creatures by means of little bladders which are attached to their stems. The entrance to these receptacles is guarded by a little door, which can be opened easily from the exterior but may not be pushed aside from the interior. At the present time the bladders of the Utricularia are small, but there is no reason to suppose that they will always remain so. It is quite likely that they may increase in size so that they are able to grapple with good-sized fish and other water animals.

In these far-away days of which we have been speculating, plants will be divided into wild and tame sorts in the very real sense of the words. The botanical gardens of the time will be far more exciting than are the zoological collections of to-day. It is fortunate that all natural changes come about with great slowness, and it may be that the condition of man himself will have changed considerably by the time he is called upon to face these aggressive plants. It is to be hoped that this may be so, otherwise the outlook for the human race is distinctly disquieting.

◆

A New Substitute for Cotton.

(Concluded from page 470.)

German East Africa, and the exports thence to Germany are steadily increasing. So far, little attention has been given to cocoanut fiber and the fiber of the many palms growing in the protectorates has been allowed to run to waste. With a view to becoming independent of foreign countries for her supplies of this fiber, Germany is also going to see what can be done with the product of her own colonies. The whole aim of the German is to become "independent" and as far as possible, do without foreign goods and foreign labor. Other instances could be given of this, were they not quite outside the scope of the present article.

◆

POWER-DRIVEN SCOOTER.

(Concluded from page 472.)

wheel clear of the ice when the engine is being started. This is accomplished by a lever of ⅝ x 1-inch iron placed and bent as shown in Fig. 1. When starting the motor the lever is pulled back and a small wedge of wood is slipped between it and the engine bed. After the motor has got going nicely it is slowed down and the lever gently relaxed, allowing the teeth to take a slight hold. As the craft gathers headway increase the power and also the pressure on the spikes until the lever is slack and the motor running at its maximum power. To stop, slow down and raise the wheel off the ice.

The construction of the rudder is simple. The stock is of ¾-inch iron 12 inches long. An 18-inch tiller of forged iron is pinned to the post with a ¼-inch pin. The stock is recessed and pinned to the iron yoke which carries the runner. This yoke is forged out of 1¼-inch iron and has a collar slipped over its shoulder to wear against another collar or flange fastened to the bottom to act as a bearing. A ½-inch pin secures the yoke to the runner. The runner blade is of ¾-inch oak 1 foot 7 inches long and 2½ inches high.

For the shoe use a piece of soft iron ¼ inch deep and ¾ inch wide, cut to a V edge at an angle of 45 degrees on each side. The shoe should have a rocker of about ½ inch for the 15½ inches it is supposed to bear on the ice. It should have 5 inches bearing forward of the rudder pin and 5½ aft. The shoe is held to the runner by three ⅜ through bolts riveted and smoothed off. A guard is placed under the boat to prevent the runner from catching in obstructions.

The engine can now be installed. For a foundation use two 1¼ inch oak stringers running along four frames and shaped and spaced as per requirements of engine used. The stringers should be through bolted from the outside of planking to top of the bed and drawn up tight and solid.

Now set the motor in its bed and fasten down with ½-inch lag screws 3 inches long. The exhaust is piped over the side and the water and gasoline tanks are situated on the forward deck. They each hold 3 gallons, and should be made out of 18-ounce copper. The piping is led down through the mast hole along the floor to the motor. It should be of copper tubing, ¼ inch for the gasoline and 1¼ inch for the water.

The batteries and coil are placed just under the tanks. Six dry cells are sufficient. In order to have the scooter trim with one person on the seat it will be necessary to put about 60 pounds of lead up forward as shown. As the keels of these boats are rockered, attention must be paid to this or else the pressure on the rudder will be too great or it will be lifted clear.

A ½ inch heavy motor cycle roller chain should stand the strain with care but as to the diameter of sprockets experiments would have to determine this as it would vary for every type of motor. With the driving wheel turning up 700 revolutions per minute the scooter would be going about 33 miles per hour. If the motor could turn up to that or over it would be better to let it run up and gear it down.

With a motor of six or seven horsepower and turning 700 to 800 per minute I would use for a starter an 8-inch sprocket on the driver and a 7 inch one on the engine.

(Concluded from page 478.)

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Wrapping machine, A. M. Price	[illegible]
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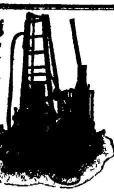

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The automobile has presented to the road engineer new problems for solution. He must render his roads impervious to water and practically proof against the destructive effect of tires. The United States Government through the Office of Public Road Inquiry is now studying this subject. The article written by Mr Page, Director of the Office of Public Roads, describes what has been done.

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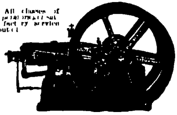

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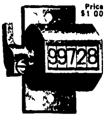

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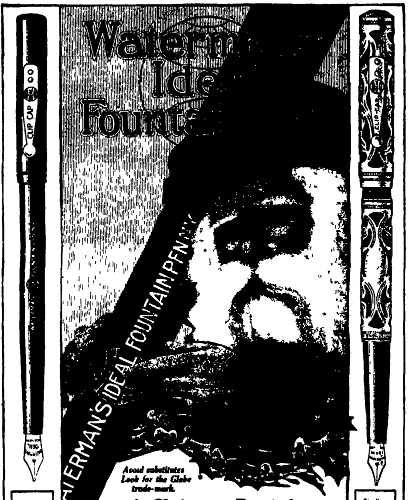

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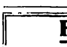

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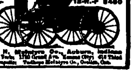

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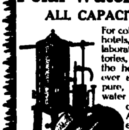

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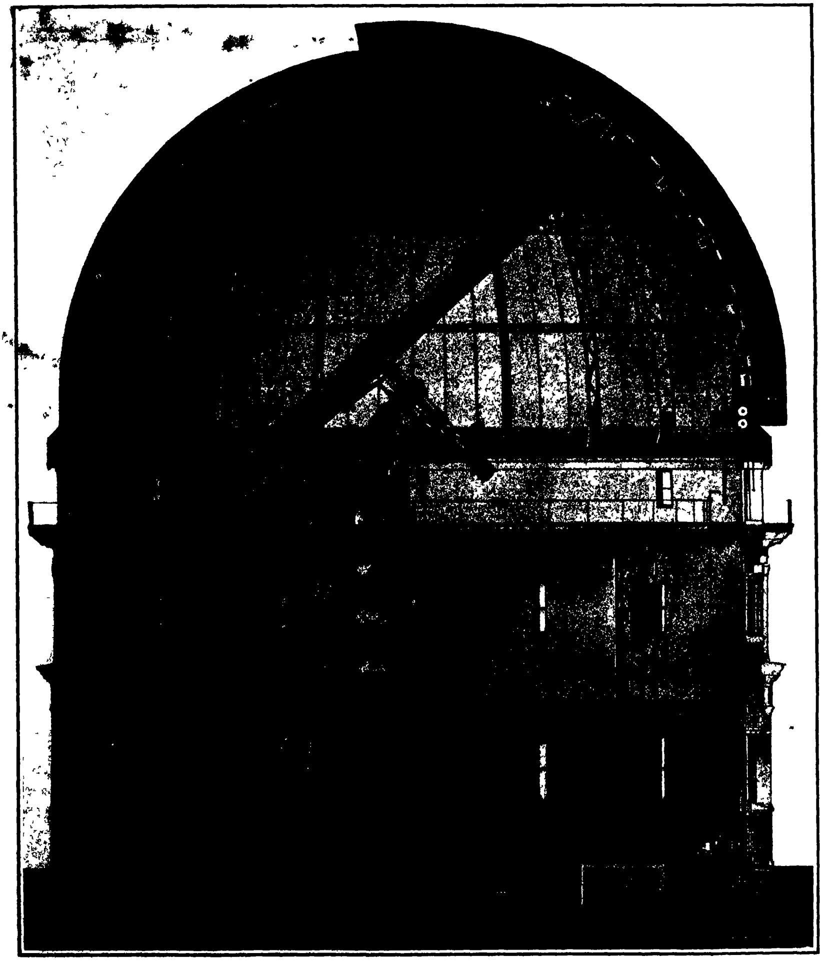

Section taken through the 90-foot dome of the Yerkes Observatory, showing the mounting of the 40-inch telescope and the 75 foot elevating floor

PHOTOGRAPHING A STAR SPECTRUM.—[See page 485.]

SCIENTIFIC AMERICAN

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NEW YORK SATURDAY, DECEMBER 25th, 1909

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates

A WARNING.

It is quite conceivable that the great loss of property and the equally serious loss of prestige occasioned by the fall of the Quebec Bridge have been already fully compensated by the valuable lessons learned from that disaster It was worth the loss of a Quebec Bridge to learn that tests of the strength of a small model can no longer be taken as a basis in estimating the strength of a structure which is an exact reproduction of that model on much larger scale. That was the principal illuminating fact brought out by the commission which made an exhaustive examination of the wrecked bridge. Furthermore, it was proved that when the members of a framed structure are themselves made up of a large number of assembled pieces, as in the case of built-up chords, posts, girders, etc, the results obtained on the smaller models are particularly unreliable in determining the strength of the full-size members.

If it be necessary to proceed with caution in the case of a structure in which the assembled parts consist of the same kind of material possessing similar elasticity and breaking strength, there is a call for even greater caution when the materials of construction are not homogeneous, and the bond between them is of a more or less doubtful character This last condition exists in the case of reinforced concrete construction, and especially when it is used in the building of truss bridges and similar framed structures.

We are therefore in thorough accord with our esteemed contemporary Engineering News when it draws attention editorially to the construction of a reinforced concrete truss, the strength of which was determined, or attempted to be determined, by the testing of a model of one-tenth the linear dimensions and one-hundredth the cross-sectional dimensions of the finished bridge Our readers will remember that in the various failures which we have recorded of reinforced concrete, the breakdown has most frequently occurred at the points of junction of one member to another, such, for instance, as the connection between a floor beam and a vertical post It is admittedly difficult to design these connections in such a way as to render it possible to determine their strength with the same certainty that obtains in designing such a connection in an all-steel structure, and a concrete truss bridge, because of the multiplicity of the joints and the complicated character of the stresses which occur, must be particularly liable to this uncertainty

We have no wish to throw any general doubt upon reinforced concrete construction as such, but we do believe that now that a determined effort is being made to apply the system to the more difficult problems of bridge work our engineers should proceed with the greatest caution, and advance only upon well-proved data The call for testing machines capable of trying out to absolute destruction the largest size members is particularly urgent when these members are built up of such widely different materials as steel and concrete, the strength of the bond between which is greatly dependent upon careful work during erection.

ELECTRIFICATION OF A CHICAGO RAILWAY TERMINAL.

At a recent meeting of the stockholders of the Illinois Central Railway, the proposal to electrify the terminal lines of that company in the city of Chicago was rejected. The city now proposes to force the hand of the railway company by means of local ordinances. The railway company objects to the change on the ground, first, that there is a heavy [illegible] of traffic w[illegible] other railways that use the Illinois Central terminal, and secondly, that the main line and suburban passenger and freight tracks are all included in the terminal system. Therefore, it would be difficult and enormously expensive to equip the entire system for electric traction, while serious difficulties and dangers would result from the operation of the yard and the switching service by electric traction.

These objections have a familiar sound in the ears of residents of New York city, who have not forgotten the agitation which preceded the wonderfully successful installation of electric traction at the terminal of the New York Central Railroad Company in this city. They are also mindful of the fact that, long before the electric service was in full operation, the Chief Engineer of the railroad announced that the benefits derived by the railroad company itself, to say nothing of its patrons, from the new service exceeded even the most sanguine expectations. Not only was the city freed from the nuisance of smoke and noise, but the railroad company itself was able to handle its trains more expeditiously, and to reduce the number of train movements enormously Although no definite figures have been given out as to the decrease in the cost of operation, it is generally understood that the reduction has been very considerable

We confess to considerable surprise that so enlightened a journal as Engineering News should side with the Illinois Central Railway in its present obstructionist policy, which it does by stating that it is "unreasonable to make the objection of the people of Chicago to the noise and dirt from the engines a basis for saddling the railways with the enormous cost of converting the entire terminal system to electric traction"

It seems to us a simple matter of equity that the holders of a valuable franchise should bear the expense of any changes that will render their operations under that franchise as free as possible from inconvenience and nuisance to the city that gave it The smoke and noise arising from the operation of the Illinois Central tracks by steam, constitute a most serious disfigurement and drawback to the Chicago water front, and the great improvement which resulted from the electrification of the terminal of the New York Central Railroad will be even more marked in the long stretch of water front which is now so greatly marred by existing conditions at Chicago.

REPORT OF THE NAVAL BUREAU OF ORDNANCE.

We learn from the report of Rear Admiral Mason, Chief of the Naval Bureau of Ordnance, that the tests of the new 12-inch 50-caliber gun showed it to be fully equal to any gun of that caliber thus far proposed for any navy In the proving ground tests it developed an initial velocity of 3,030 feet per second and a muzzle energy of 52,500 tons. This is the gun that will be mounted on our two largest "Dreadnoughts," the "Arkansas" and "Wyoming," which will carry twelve guns of this pattern. More powerful than this, however, will be the new 14-inch type gun, which will pass through its tests before the end of the present year It is designed to fire a 1,400-pound projectile with a velocity of 2,600 feet per second and a muzzle energy of 65,600 tons.

It is gratifying to learn that our present nitrocellulose powder has been developed to a point which leaves little room for improvement. Moreover, a new pattern of projectile is now being built, carrying the long pointed head that has been found to give such good results in small arms, which has shown a considerable increase in range, flatness of trajectory, danger space, striking velocity, and penetration at the longer ranges. Our older guns have been modernized, and this work has included the relining and strengthening of the 12-inch guns of our battleships of a date prior to, and including, the "Virginia" class.

The Bureau is much gratified at the remarkable results which have been obtained in target practice with equipment which was designed many years before the present principles and demands of target practice had been developed; and a new system of sighting mechanism has been worked out, and is being applied to all turret guns. Our latest ships are being fitted with complete refrigerating plants for the cooling of the magazines, and the magazines of the older ships are to be similarly fitted as opportunity offers. Changes have been made in the rotation band of projectiles, which will considerably prolong the accuracy life of the projectiles after the gun has been so much worn that its accuracy with the older bands would have been much impaired.

THE ARMY ORDNANCE REPORT.

In his Annual Report, Gen. Crozier, Chief of Ordnance, U. S. A., speaking of the occasional failures of heavy guns, states that the trouble arises not from a defect in the design of the guns, but from occasional defects in the forgings or the development of erosion or heat cracks. The danger arising from imperfections [illegible] been [illegible] greater [illegible] as [illegible] remedy [illegible] as soon as [illegible] nounced. [illegible] ber and over [illegible] mortars [illegible] double tubes, so that, should the inner tube [illegible] the damage will not extend to the outer [illegible] enveloping jacket and hoops. This will [illegible] restoration at small cost of guns [illegible] and will facilitate the rehabilitation of guns whose accuracy has been lost through erosion and wear of the bore.

The six 6-inch and four 14-inch guns [illegible] by Congress at its last session will be of the [illegible] type and will have [illegible] 14-inch guns the caliber length [illegible] calibers, as in the guns now under construction [illegible] calibers. Within the next few months the Department hopes to test the new [illegible]-caliber 14-inch wire-wound gun and one of the new 12-inch wire-wound mortars.

The construction of hand grenades for the army marks the reintroduction of an ancient form of weapon. They were used with good effect, we believe, in the Russo-Japanese war. The grenade can be thrown by hand a distance of about 150 feet from a standing position. Lieut.-Col. Babbitt has designed a rifle-shrapnel grenade to be fired from the musket carried by the infantry. Troops will be furnished with both the hand and rifle-shrapnel grenades in a reasonable quantity whenever there is a call for them.

Another item of interest gleaned from the report is that Gen Crozier is of the opinion that the government can now manufacture cheaper than it can buy; that is, if everything is taken into account except the manufacturers' profit. As an instance of this, he quotes the fact that the 3-inch field gun, which under contract costs $2,020.90, can be manufactured at the arsenals for $1,276.90, and that the 12-inch disappearing carriages, which cost under contract [illegible], cost only $605.35 when built at the arsenals.

THE ORIGIN OF EUROPEAN PEOPLES.

In a recently published work on the origin of European peoples, Sergi recognizes eight races of men, only three of which have left remains in caverns. These races are *Homo Europaeus*, *H. Eurafricanus*, *H. Eurasicus* The first race is extinct. It was characterized by a very low forehead and an enormous protrusion of the glabellum and the superciliary arches, forming a sort of visor. Remains of this race have been found at Taubach, Krapina, Neanderthal, Spy, Schipka, La Naulette, and Malarnaud. Sergi assigns the middle of the Pliocene as the period of this race.

The second race is still in existence. It has a visorless skull, dolichocephalic or mesocephalic. It came from the north of Africa and has left remains in the loess of Egisheim, Galley Hill (England) and Predmost (Moravia), and in the caves of Laugerie, Chancelade, and Baousse-Rousse. Sergi attributes to this race the paleolithic civilization of the later Quaternary in the south of France, and finds in that civilization analogies with the Mycenaean or prehistoric Egyptian civilization, apparently later than the Quaternary but in reality contemporaneous with it in the development of the arts. There is no apparent reason why this race should not have penetrated into the southwest of France.

The synchronism of two ages, however, is very difficult to prove, because the paleontological criterion of the Quaternary is not uniform throughout Europe, owing to differences in climate. For example, no trace of *Elephas primigenius*, *Rhinoceros tichorhinus*, or *Cervus tarandus* has yet been found in Italy.

Homo Eurafricanus persisted into the neolithic age at Cro-Magnon, [illegible] toward the end of the [illegible] (Homo [illegible]) [illegible] Asia and [illegible] in the [illegible]

[illegible]

ENGINEERING.

The "Vanguard," the new British "Dreadnought," recently completed an eight-hour trial at the remarkable speed of 22.4 knots, a full knot in excess of the Admiralty's stipulation.

In the endeavor to apply a slow-speed turbine economically to cargo steamers the Parsons Company purchased the cargo steamer "Vespasian," and, after running her with a careful record of steam and coal consumption, they have taken out the engine and put in turbine machinery of the same power The vessel is now being run under exactly similar conditions as to load and speed, and, before long, valuable particulars of the relative efficiency of the two types of engine will be available.

A number of motor cars for the suburban service of the New Haven Railroad are now being completed at the Westinghouse shops. They are 70 feet long, weigh 86 tons, and seat 72 persons. The cars are equipped with motors of 200 horse-power, and each is guaranteed to haul two 50-ton trailers at a normal acceleration of 0 7 mile per hour per second They are designed to operate on both the 11,000-volt alternating current of the New Haven, and the 600-volt direct current of the New York Central Railroad

The Public Service Commission for New York city has published designs for the elevated portions of the new subways, which have been approved by the Municipal Arts Commission. They embody, among other things, a scheme for deadening the noise of the trains, which consists of a concrete floor, 11 to 15 inches in thickness, upon which the wooden ties will be laid. The æsthetic appearance of the structures will be improved by the use of curved steel brackets connecting the columns with the longitudinal and transverse girders.

According to a report from Washington, the officers of our latest and fastest torpedo boats of the "Flusser" and "Reid" type, which have made a speed of over thirty-three knots on trial, are to be furnished with special headgear equipped with a form of automobile goggles to protect them against the fierce rush of wind and spray Thirty-three knots is equal to about thirty-eight miles an hour, and at this speed, especially when steaming against a strong wind, some form of protection to the eyes becomes a positive necessity

The New Haven Railroad is constructing a mile of experimental overhead trolley line beyond the Stamford terminus of its present electrical road. The new system is designed to lessen the weight and cost, and eliminate certain undesirable features, of the existing style of construction from Woodlawn to Stamford Apart from the reduced cost, the new construction will have the great advantage that the trolley wire only will be alive and carried upon the customary insulators, breakages of which have been frequent. The main cables will be strung directly from the supporting columns.

In a series of experiments to determine whether concrete could be conveyed in the plastic condition from the place of mixing to the point where it was to be deposited, Messrs. Bussell and Larkin recently made some experiments which seem to determine the feasibility of this plan The experimental plant, as described in Engineering News, consisted of a hopper tank maintained under compressed air, in which the concrete was placed, and from which a pipe led to the point of deposit. Half a cubic yard of broken stone concrete was deposited at the end of 400 feet of 4-inch pipe in less than 5 seconds.

The second attempt to raise the United States cruiser "Yankee" to the surface of Buzzard's Bay failed at the very moment when it appeared to be successful. The method adopted, as explained and illustrated in our issue of November 27th, was to exclude the water from certain compartments by forcing in air under pressure, and thereby give the vessel sufficient buoyancy to bring her to the surface. On December 2nd the vessel was raised until the top of the deckhouse aft was three feet above the water At this stage a certain portion of the hull or deck gave way, allowing the air to escape, and the vessel settled to the bottom. Further details of the mishap will be given in a later issue.

In an exhaustive analysis of the various types of aeroplane, a writer in Engineering gives the following particulars: The Wright biplane for each horse-power weighs 41.6 pounds and spreads 21.6 square feet of surface. For the Farman biplane the respective quantities are 34.2 pounds and 8.3 square feet; and for the Curtiss biplane, 18.5 pounds and 9 square feet. Among the monoplanes the Antoinette, per horse-power, weighs 20.8 pounds and spreads 7.2 square feet of surface; the Bleriot weighs 19.2 pounds per horse-power and spreads 6 square feet; while Santos Dumont's little machine, the "Demoiselle," weighs only 8 pounds per horse-power, or one-fifth as much, and spreads 3.8 square feet of surface per horse-power, or less than one-fifth as much as the Wright machine.

ELECTRICITY

An International Congress of Radiology and Electricity will be held at Brussels next year on September 6th, 7th, and 8th. The subjects to be taken up for discussion are the methods of measuring radioactivity, theories of electricity and radiations, and the effect of radiation on living organisms

The American Electro-Chemical Society has appointed a committee to devise a method of rating and testing dry cells. The present methods have long been considered unsatisfactory, but have continued in force because of the difficulty of obtaining a rating which would be applicable for the various uses of the cell.

A new safety lamp for miners has been invented, comprising a battery and a metal filament lamp which are completely incased. The circuit of the lamp is kept closed by means of a spring-pressed rod bearing against a light ring on the glass casing of the lamp Should the glass be broken, the ring would be sure to break or be displaced, opening the circuit of the lamp so that there would be no danger of igniting the gases with the incandescent filament

The city of Chicago is discussing the possibility of utilizing the water power obtainable from the Drainage Canal to extend the street lighting system A large part of the city is illuminated with gas and gasoline lamps but by making use of the power from the Drainage Canal these lights could be replaced with electric arcs. There are 18,000 arc lamps now in use, and if the gas and gasoline lamps are done away with, 29,000 arcs will be required

During one of the automobile endurance tests between San Antonio and Dallas, Texas, one of the entrants, who is president of a telephone company, carried telephone apparatus with him, and by using a long fishing pole could tap the telephone lines along the route without leaving his car By this means he was able to keep in touch with points in advance of the run and arrange for relief in case of accident or for hotel accommodations

The city of Austin, Texas, used to have a large lake, formed by a huge dam built across the Colorado River This dam was 1,275 foot long and 67 feet high above bedrock A plant placed just below the dam converted the water power into electricity, which was used for lighting the city and operating the street railways, as well as for a number of industrial plants In 1900 the dam and power plant were washed away by a flood, and the city was too crippled to replace them A movement is on foot now to rebuild this dam, making it of reinforced concrete The power obtainable will probably attract many manufacturing industries, which would undoubtedly contribute materially to the development and growth of the city

Now that Christmas is here, and amateurs are lighting their trees with electricity, it is well to call attention to the warning issued by the Chicago Board of Underwriters to the general public, and especially to merchants who have holiday window displays Ordinary Christmas decorations are highly inflammable, and it is even more important to take every precaution with the wiring than if the wiring were to be permanently used in the store or house Chicago merchants have been warned to have special watchmen keep guard at their windows during the danger season.

A new form of mercury interrupter has recently been invented in which there are no reciprocating parts, but the interruptions are produced by a ripple formed in a stream of mercury The mercury is contained in a revolving vessel within which a contact piece is fixed The mercury is thrown by centrifugal force to the inner periphery of the vessel. At one point the stream of mercury is obliged to pass over a deflector, producing a ripple or wave, and the contact piece dips into the mercury stream at this point as it revolves with the vessel The frequency of the interruptions may be varied by having the deflector revolve slowly in the same direction as the vessel is revolving, or in the opposite direction, or having it remain stationary

An inventor has recently devised a form of explorer for locating conductors when searching for faults in a high-tension underground cable. It depends for its operation upon the fact that the three conductors of the ordinary cable are spirally wound with a pitch or "lay" of 20 inches. By connecting two of the conductors at the power station, signals which are sent out hrough the conductors form magnetic lines of force that lie at right angles to those produced by ground currents in the sheath of the cable Consequently, the magnetic circuit of the instrument is unaffected by these currents. By using a double telephone receiver in connection with the instrument signaling currents sent over the line produce very intense sound when the explorer is on the sheath and the sound is quite noticeable, even when the explorer is placed on the tile duct outside.

SCIENCE.

Dr. Ludwig Mond, the distinguished chemist, died on December 11th in his London residence at the age of sixty years. Dr Mond was well known as the inventor of many valuable commercial processes, among them the process for the manufacture of ammonia and soda and producer gas.

In view of recent discussion concerning the possibility of adopting an international set of symbols for the principal electrical engineering quantities, Prof A. E. Kennelly has made a statistical examination of recent textbooks in various countries. The results of his examination are published in the Electrical World It seems that there are twenty-one quantities in the list and fifteen subsidiary fundamental quantities.

In his "Reminiscences of an Astronomer," the late Prof Simon Newcomb took occasion to pay a tribute to the brilliant work of Dr George W Hill of West Nyack, N Y That tribute was paid we suspect not only because Prof Newcomb admired Dr Hill's remarkable mathematical attainments but also because he wished to drive home to the public some conception of the value of his service as one of the Naval Observatory staff No doubt Prof Newcomb would have rejoiced with every American scientific man in the awarding of the Copley Medal to Dr George W Hill, the highest distinction conferred by the Royal Society

An earthquake was recently felt at a mineral spring in Austria. Soon after the shock the water of the spring was found to deposit a brown sediment and to evolve more carbon dioxide than usual The water soon became clear but the abnormal evolution of gas continued for several hours Mineral springs at great distances from the center of disturbance have often been observed to be affected by earthquakes Prof Suess explains the phenomenon as follows Agitation of a supersaturated gas solution causes a rapid evolution of gas, as may be proved by shaking a bottle of soda water The gas is evolved still more copiously when the solution is thrown into molecular vibration After an earthquake the rocks surrounding even distant springs are thrown into vibration, which is transmitted to the water causing rapid evolution of gas, expansion of the mixture of gas and water and expulsion of solid particles

The Radium Institute of America was formed at a meeting in the building of the New York Yacht Club recently The purpose is to study radium, discover any radioferous deposits in the United States, and buy quantities of it in Europe for clinical use in the United States. It is the idea of the founders to establish a clinic in connection with some New York hospital, where radium treatment will be administered free to those needing it The Institute will take steps to protect the public from the false claims of patent medicine manufacturers that certain of their remedies contain radium, and will set a standard that those desiring to deal in radium commercially will have to live up to Dr Charles F Chandler was elected president, Dr Robert Abbe, vice-president Prof William Hallock, secretary, Prof George B Betram, assistant secretary, and Dr Hugo Lieber treasurer

Prof. A. Mallock has made a careful study of the utilization of the energy stored in springs for the production of mechanical work with the object of showing in what way the work stored in stretched India rubber may be most fully utilized so as to supply power at a constant rate It seems that the most convenient form in which the India rubber can be used is that of a long strip or band wound on a drum or reel under tension, and in order to convert the potential energy into mechanical work Prof Mallock shows the conversion cannot be effected continuously but must proceed in cycles and that the condition of efficiency is that each portion of the elastic band whose contraction is being utilized must be unwound from the drum without change of tension and that the part so unwound must then be isolated by clamping or otherwise and allowed to contract without contact with other bodies except at the clamped ends

The third annual convention of the American Society of Agricultural Engineers will be held at the Iowa State College Ames Iowa on December 28th and 29th The society was formed at Madison Wis in 1908 by a few men, most of whom were then engaged in teaching agricultural engineering in the universities throughout the country The importance of the work to be accomplished by such an organization was soon realized by prominent manufacturers and others interested in this field both commercially and professionally, the result being that during the last two years the membership of the society was increased fully four hundred per cent A word explaining the term "agricultural engineering may be of interest to many who have not become fully acquainted with the work. Within the scope of the term falls a study of farm machinery farm buildings farm conveniences and irrigation and drainage In short it deals with the mechanical side of farm life involving teaching, investigation, and manufacturing activities

A NEW THEORY OF THE SCREW PROPELLER.

Prof. Oswald Flamm of the Technische Hochschule at Charlottenburg, the principal engineering school of Germany, very recently completed a remarkable investigation of the action of a ship's screw propeller As a lecturer on naval architecture and engineering, he admitted that the theory of the marine screw had worked out very indifferently in practice. His investigation, which involved formidable complications, was reduced to a highly mathematical form, but on concluding his practical experiments, Flamm was nearly ready to deny that the theory had any real value. Propellers elaborately calculated on that theory were found, in practice, to require so much "cutting and trying" that calculation was simply wasted. The entire theory is now regarded by him as a mere dry abstraction It gives no clear idea of the precise physical motion that a screw imparts to water

Flamm finds that the most obvious features of a ship s screw were entirely overlooked by its originators, yet these very features indicate the real reasons for a propeller's action One of these was the seething mass of water immediately behind a steamer's stern, and another, that familiar condition of any cast off propeller, that when they have lost their usefulness they have a peculiar shape The edges of the blades are always rough and irregular through erosion. Why are only the ends in that condition while the hub remains unimpaired? Prof Flamm's experiments not only explain this paradox but also dispose of two very common notions, that a screw at the highest speed of its revolution, loses propelling effect through 'cavitation" (a vacuum formed in the water behind the blades) and that the propelling effect may be increased by inclosing the propeller in a tube to prevent water that is being acted upon, from escaping at the sides.

VELOCITY OF PROPELLER, 8 METERS PER SECOND.

Flamm s method of investigation meets the problem so clearly and fits the requirements so perfectly that it seems odd he should have been the first to try it. Much of our useful knowledge about screw propellers has been obtained at great expense by fitting propellers of various designs to a ship and in this way, measuring their efficiency Flamm constructed a testing apparatus which reproduced similar conditions on a small scale at less cost, and at the same time permitted more complete and accurate observation and measurement.

A screw was observed while it was propelling. The minutest features of the process, the water itself, were photographed by means of extremely sensitive plates that gave perfect pictures at exposures of only 1/1000 part of a second. It had been intended to make the stream lines visible by adding an opaque powdery substance to the water, as used successfully in photographing the stream lines around moving bodies This was not necessary, enough air was mixed with the water by the propeller to make the screw s movement plainly visible These pictures were stereoscopic and kinematographic views. The apparatus was very simple, a long glass tank filled with water, over which ran a small car along a railing, to the car was attached an electrically-driven screw propeller immersed in the water There was no track resistance to the car, to which was fastened a cord running over a pulley at one end of the tank This cord was attached to a cup for holding weights. The cup's range of fall was as long as the tank, therefore the resistance of the car to propulsion was measured with exactness. From one side of the tank two electric arc lights of 24 000 combined candle-power, sent their rays through the water on the level of the propeller, to the photographic lens on the opposite side The tank was 32 feet and 9 inches long and 2 feet and 7 inches wide and deep, the diameter of the propeller was less than 4 inches. Fourteen different patterns were tested, including all the standard types. Accurate measurements were obtained of the number of the propeller's revolutions and of its push but the amount of energy it consumed could not be determined with the same accuracy in this simple apparatus nor was it possible to ascertain the maximum push any certain propeller was capable of giving except when the car was held stationary Even so, many conclusions may be drawn. It is evident that a propeller's efficiency depends on the processes in the water, and that these processes obey definite laws. Flamm discovered a sucking action to be the real basis of the efficiency of all screw propellers. In naval practice, a ship s propeller is quite near the meeting line of water and air, this fact gives the sucking action a peculiar "by-effect" that is so incidental and variable, it has escaped much critical attention. As a result, all former theorising was futile.

All the Flamm pictures show a positive dent in the water-level, immediately above the screw's periphery—the water is being sucked down to the screw's center with such force that it cannot flow in quickly enough from the sides to fill up the vortex. Flamm states that this dent exists even around a freight steamer's propeller when it is so far out of the water that the top blade projects above the surface. The water's quick turbulency on the slopes of this dent engulfs air, which is taken down to the blades, this peculiar adhesion and attraction between air and water produces foam. Consequently, the screw does not work on water alone but on water mixed with more or less air Thus is explained the paradox, how an implement placed as far below the surface as a ship's screw, whips the water into a frothing mass. Another fact, hitherto unsuspected, is presented by these experiments What has been called the propeller's "slip," that difference between its pitch speed and the velocity with which it drives the ship, is variable for the same energy and size and shape of the screw. It depends on the volume of air that is sucked in, this in turn depends on various conditions.

PROPELLER SUCKING IN AIR FROM SURFACE.

Flamm found that the phenomenon attending any sudden loss of efficiency of a ship's propeller when it is driven above a certain number of revolutions a minute, was not one of "cavitation," as heretofore assumed. "Cavitation" has been explained as the hollowing out of water by the screw, meaning that the blades when passing too rapidly through the water, leave an instantaneous vacuum in their wake, thus losing their "grip" on the water, as a whip-lash leaves a vacuum in the air On the contrary, it has been demonstrated that in all these cases of so-called "cavitation," the suction from the water's surface had become so strong that an immense volume of air rushed in from above, with the suddenness of an explosion. The water is instantly whipped into foam around the propeller, the blades lose all hold and the screw races away furiously as it does when lifted entirely out of the water when the ship pitches violently In Flamm's experiment, with the propeller working at very high speed, the car was dragged back by the weight in the cup.

There was an obvious remedy either under the experimental conditions or in water more or less smooth. When the car was fitted with a board that covered the water-level on top of the revolving screw, it permitted running the propeller even at higher speed; no "cavitation" occurred because the air was excluded. The efficiency of a ship's propeller may also be increased by a stern having a long overhang immediately below the surface. [illegible] any air screen [illegible] that would [illegible] the water [illegible] half-cylinder of [illegible] would be useless. Everything therefore [illegible] the screw as far below the surface as possible. This seems to explain the efficiency that is obtained in fast motor boats by inclining the propeller's axis. Even a layer of water no deeper than the screw's diameter was not a very efficient shield against the entrainment of air. It was still more curious that when the revolving speed at which the board excluded "cavitation" was only slightly exceeded, "air tubes" were formed in the water. These traveled from the edge of the board to the propeller, again destroying efficiency. It was necessary to have the shielding board of ample size.

Observations of a worm-shaped air-space behind the hub of the experimental screws were not productive of much surprise. This was a neutral space without suction or pressure, as indicated by introducing a small tube. Air blown through that tube considerably increased the waterless space below the surface. Nevertheless, Flamm found that true "cavitation" exists, but that, quite contrary to established notions, it marks the very climax of a screw's efficiency. As this efficiency depends to its greatest extent on suction, it becomes evident that a screw is most efficient at the moment there is enough suction to actually create a vacuum. "Cavitation" is wasteful in that from the instant it begins, any increasing of the number of revolutions per minute does not increase the propeller's efficiency at the same rate that it costs power It cannot increase a suction that is already at its maximum. These tests of real "cavitation" were conducted under a large protecting board. It was also found that starting a screw very suddenly increased the air-suction to a marked extent.

VELOCITY OF PROPELLER, 3.7 METERS PER SECOND.

Prof. Flamm obtained a great number of excellent photographs. The air sucked in not only illustrates the stream lines next to the propeller but also reveals the wake of the blades for considerable distance behind the propeller On examining these photographs, the reason propellers corrode at the edges of the blades, becomes very clear, especially upon considering that each little dent when first created by the erosion becomes a nest for air bubbles. Suction is strongest at the edges of the blades. Prof Flamm also gave great attention to skin friction of the water He advises running a propeller rapidly because the friction that forms an important part of its resistance to revolving, increases at a lower power of the speed than its push, and because "cavitation" may be obtained with a small screw He found wide blades wasteful of power He designed a very efficient screw with increasing pitch and narrow blades. These trials are to be resumed on a larger scale.

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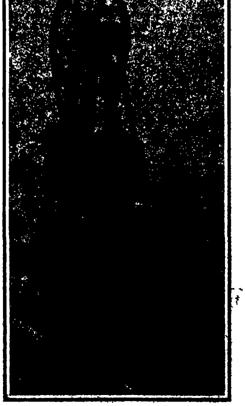
A MACHINE FOR SIMULTANEOUSLY FIRING MANY BLASTS.

BY FRANK C. PERKINS.



A MACHINE FOR FIRING BLASTS SIMULTANEOUSLY.

The electric machine for exploding blasts pictured in the accompanying illustration is said to effect a reduction of one-third in the amount of explosive used, on account of the simultaneous firing of the charges.

All the charges must be exploded at the same instant, this being far more effective than a number of intermittent explosions, separated even by only a fraction of a second.

The electric firing machine illustrated consists of a small dynamo of 12 volts pressure mounted on the base of the machine, and driven with a crank by means of sprocket wheels and chains, the best results being obtained from a dynamo 25 per cent over-compounded. By the use of the hand-operated machine, it is stated that one hundred casts have been fired at one time, all of the charges exploding precisely at the same instant.

An electro-magnetic switch, mounted on a marble slab on the front of the machine, accomplishes this desired end, and the current from the dynamo first passing around the coil of the electro-magnet, which has an iron core. The magnetic strength of the iron core increases as the current around the coil becomes stronger while the dynamo is being speeded up. When the electric generator is working at full speed and the current is strong enough to explode all the fuses at once, a vertical armature is pulled over, and its lower edge is sufficiently separated. A spring on the vertical shaft noted at the right of the coil in the illustration is thereby released, and a spring pulls the switch [illegible] with a jerk. A switch beneath the coil is [illegible]

(Concluded on page [illegible].)

A POLLEN-GATHERING PATENT DEDICATED TO THE PUBLIC.

Mr. [illegible] Moulié of Jacksonville, Fla., has invented a pollen-gathering device, patents for which he has dedicated to the public, for the general good. Furthermore, he will place the device at the disposal of scientific men who are interested in the gathering of pollen. The apparatus is suitable for universities and colleges, and such institutions where botany is taught.

The importance of the invention may perhaps be gaged if we consider the previous methods of gathering pollen. With the first of his machines Mr. Moulié, under the most favorable circumstances, gathered one and a half ounces of pure pollen of the ragweed (*Ambrosia Artemisiæfolia*) in three days, and this with three charges of twigs, one for each day. It was the opinion of the late Prof. A. A. Curtiss, a prominent botanist, formerly connected with the Smithsonian Institution, that to collect that amount of pollen it would have taken one hundred persons thirty-six hours.

Mr. Moulié's device consists of a vessel provided with means for holding the slips or twigs bearing the blossoms from which the pollen is to be collected. The vessel is filled with water, so as to keep the twigs fresh and ripen the blossoms. The blossoms overhang the edge of the vessel, so that the pollen falls upon a paper sheet spread closely around the bottom of the vessel, which bottom is narrower than the top of the vessel, so that the paper is free to be removed without touching the vessel. The vessel or tank is made of sheet metal. Over the top of the tank is a sheet metal plate supported over two longitudinal and two transverse rods, the edges of the plate being bent around the rods. This cover plate is smaller in area than the top of the tank, so that a narrow channel or opening is formed around the entire perimeter of the plate. The rods project across this opening, their ends being bent over the rim of the tank. Into the openings around the plate the twigs and branches are inserted, their lower limbs being immersed in water. The branches are tilted, so that their upper ends project beyond the sides of the tank. To keep them in this position, and to prevent them from sliding too far into the tank, the cover is cut at the center to form a pair of flaps, which are bent outward and engage the stems. As previously stated, the tank is surrounded by sheets of paper, on which the pollen falls as the blossom ripens. The ripening is brought about by the gradual rise of temperature in the room where the operation takes place. When desired, the water in the tank may be drawn off without disturbing the branches, through a tube connected with a stopcock near the bottom of the tank. Fresh water can be poured through an opening in the cover plate. The device renders it possible to collect the pollen of flowers in unlimited quantity in its full state of fertilising power, a thing impossible to be sure of by the ordinary process, hitherto the only method available. The ease with which much pollen can be collected at practically no cost renders it possible to obtain a sufficient quantity for accurate and exhaustive analysis, and to add to our knowledge of that wonderful mystery of nature, the breeding of plants. Moreover, an antitoxin for diseases such as hay fever could probably be prepared from the pollen of the ragweed. If the device served this purpose alone, it would reflect considerable credit upon its inventor.

To obtain pollen from the ragweed, Mr. Moulié selected a room having a single window exposed to the east, two windows exposed to the south, and one window exposed to the west. The apparatus was charged with twigs bearing ragweed flowers which were not quite open. The charged apparatus was placed upon a table extending from one end of the room to the other, with a space of two feet between the apparatus and the walls. The vessel was filled with clean water poured in through the opening at the top, care being taken not to spill any of the water on the flowers. The paper was then spread around the apparatus, so as to cover a sufficient space from the bottom of the apparatus to about six or eight inches beyond the perpendicular line of the top of the twigs, so that the pollen could not drop outside of the paper. The paper employed was a thick Manila brand. After the apparatus was installed, all the windows and adjacent doors were closed, and a Rochester kerosene lamp having a burner one inch in diameter was placed on the floor. To avoid the danger of fire, the lamp was placed in a large tin can. After the lamp had been lit, the apparatus was left to itself, and the door of the room locked until the next morning.

MOULIÉ POLLEN GATHERER.

The twigs selected must be used as quickly as possible after they are gathered. Moreover, they must be gathered in the morning before the sun is too high but not before they are free from moisture (dew or rain). This brings the work of gathering to about noontime. After the room is opened, care must be taken in opening the doors, so as not to create a draft which might blow the pollen off the sheets upon which it has dropped during the half day and night. The door must be closed immediately for the same reason. The temperature at that time ought to be between 85 and 88 deg. Fah. In order to gather the pollen Mr. Moulié took one sheet loaded with it and placed it on a table in an adjacent room, closing the connecting door between the rooms as well as the windows and other openings. The pollen was collected by means of a feather and dropped into wide-mouthed two-ounce jars similar to those in which vaseline is sold. The jars were filled to about one-half inch from the bottom. The collected pollen contains a certain amount of moisture which must be evaporated for safe keeping. To effect this, Mr. Moulié placed the jar or jars behind the windows in the room where the apparatus was installed, and arranged them so that they touched the windows. The rays of the sun streaming through the window pane and the glass jar caused evaporation to take place in about thirty minutes. Then after shaking gently until there were no more lumps the jars were brought into the next room and left there for one hour before they were corked. The corks selected were of the best quality and wrapped with a fine paraffine paper, so as to effect a tight closure. Small quantities of pollen can be poured in a single jar to the height of the neck. Very few readers of this journal realize what an ounce of pollen means. Perhaps some conception of the task may be had, if one imagines the collecting of an ounce of dust from the wings of butterflies.

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PHOTOGRAPHING A STAR SPECTRUM

BY PROF. S. A. MITCHELL, COLUMBIA UNIVERSITY

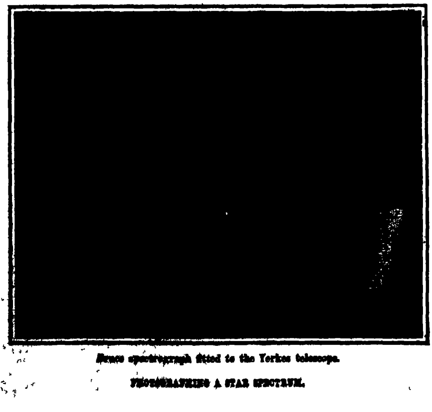
If one should go to the Sandy Hook lightship off the entrance to New York Bay and at night should see the lights of a steamer headed for the harbor, it would be practically impossible merely by looking at these lights to learn how fast the steamer was approaching. A rough guess might be made by watching the lights grow gradually brighter but it would be the roughest sort of an approximation. But the astronomer with his telescope, observing the distant stars millions on millions and millions of miles away, can tell to an absolute certainty just how fast a particular star is moving toward us or away from us, giving the motion accurately to the fraction of a mile per second. Nor is this result obtained by watching the increase or decrease in the star's light, due to its approach or recession, for the stars are so far distant that no change in their brightness would be observed in a thousand years from their change of distance alone. The measurement of a star's motion in the line of sight is one of the new fields for the astronomer, and many and valuable are the scientific results accruing from this line of work.

The writer was at the Yerkes Observatory last summer, taking part in the campaign for measuring the radial velocities of all the brighter stars that can be seen from northern latitudes and assisting in photographing the spectra of stars with the 40-inch telescope and its attached spectrograph. And what a magnificent instrument this greatest refractor in the world is! To work with this great telescope causes a feeling akin to awe in realizing that puny man, on this infinitesimal speck in the universe called earth, by the aid of such an instrument is able to fathom the depths of space and reveal the secrets of stars millions and millions of miles away. Truly there is no science which can show the matchless power of the human mind quite so well as does the old science of astronomy, the parent of all the sciences. A view of the largest refractor in the world shows also the high degree to which engineering skill has advanced in recent years, again attesting to the close union between pure and applied science.

The observatory presented to the University of Chicago by Charles T. Yerkes, is situated seventy-five miles from Chicago on the shores

(Continued on page 49[illegible])

The Yerkes telescope with floor raised to highest position.



Bruce spectrograph fitted to the Yerkes telescope.

PHOTOGRAPHING A STAR SPECTRUM.

A Proposed Revival of Spinal Anæsthetization.

A distinguished European surgeon is now visiting New York. The gentleman is Prof. Jonnesco, of the University of Bucharest, and his mission is to demonstrate the value of surgical anæsthesia without loss of consciousness. The procedure which he is understood to advocate is that of injecting into the spinal canal a solution of stovaine and strychnine. The demonstrations which he has thus far given in New York have been highly satisfactory, and it is felt that he has made great advances in the technique of spinal anæsthetization. Nevertheless, there is really nothing new in his method

The synthetic compound known as stovaine has for several years been recognized as an efficient local anæsthetic, and moreover, it has been used to some extent within the rhachidian canal There is, too, no novelty about Prof Jonnesco's procedure even in the addition of strychnine to the solution employed, for Dr J Leonard Corning, of New York, who first employed spinal anæsthetization, used strychnine with cocaine experimentally more than twenty years ago If the high point at which the injection is given is regarded as a novelty, let him who so regards it remember that, as early as in 1899 Dudley Tait had made injections between the sixth and seventh cervical vertebræ Prof Jonnesco's main achievement seems to us to lie in the fact of his nice adjustment of doses to individual cases

It must not be forgotten that the danger incident to spinal anæsthetization is not the sole cause of the comparative desuetude into which the practice has fallen, there are in many cases grave objections to the very existence of anæsthesia without loss of consciousness though there are a few surgeons who still push the use of local anæsthetics beyond what seem to us to be the bounds of reason. Local anæsthesia in its proper sphere is unquestionably a boon, for general anæsthetization has not yet been freed of all drawbacks. Nevertheless, it appears to us that, for all but minor operations, the embarrassment which may arise in consequence of a patient's consciousness must often outweigh those drawbacks

Prof Jonnesco is properly meeting with a fair hearing, but we must deprecate the newspaper notoriety with which his mission has thus far been attended, though it has been mild in comparison with what has sometimes accompanied the exploitation of similar undertakings. Its tendency is chiefly harmful by reason of its leading the public to expect the impossible and to insist upon imposing its own inferences upon surgeons who undertake major operations It is manifest that such a state of things is not only undesirable, but positively detrimental to the satisfactory practice of surgery—New York Medical Journal.

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Fraud in Electric Lamps.

English technical journals have been warning purchasers of incandescent electric lamps against swindlers who install lamps which purport to contain metallic filaments but which soon prove to be very short lived carbon filament lamps. The lamps, when first installed, give a brilliant light and appear to be very economical, as tested with the agent's ammeter but the bulbs soon become blackened, the luminosity diminishes and in a short time the lamps break—often breaking the insurance also They are simply ordinary carbon filament lamps, overloaded. When an incandescent lamp is subjected to a voltage higher than that for which it is designed it gives a very brilliant white light, and, on the other hand, the light becomes weak and reddish if too low a voltage is employed The swindle is operated by putting, for example 150-volt lamps on a 200-volt circuit. The overload of 50 volts accounts both for the initial brilliancy and for the short life of the lamps. Bulbs of ground glass are employed, so that the purchaser cannot see the alleged metallic filaments.

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Continued Ephemeris of Halley's Comet.

A letter has been received at Harvard Observatory from Father G M Searle C S P, of New York, giving the following "Continued Ephemeris of Halley's Comet. T assumed to be Apr 19 d 692 G M. T"

Gr Mean Noon. 1910.	R A (1910.0) h. m. s.	Dec. Deg. M.	Log. Δ (Sept. 11 = 1.)	Br
February 3	1 0 25	+ 8 16.2		
February 5	0 57 41	8 11.5	0.248	20
February 7	0 55 10	8 7.5		
February 9	0 52 46	8 4.0	0.252	21
February 11	0 50 29	8 1.0		
February 13	0 48 19	7 58.7	0.260	22
February 15	0 46 15	7 56.9		
February 17	0 44 17	7 55.5	0.267	24
February 19	0 42 24	7 54.5		
February 21	0 40 36	7 53.8	0.270	25
February 23	0 38 53	7 53.5		
February 25	0 37 11	7 53.6	0.275	27
February 27	0 35 33	7 53.8		
March 1	0 33 57	7 54.3	0.278	30
March 3	0 32 23	7 54.9		
March 5	0 30 51	+ 7 55.8	0.278	32

THE PHASES OF VENUS.

BY PROF FREDERIC R. HONEY, TRINITY COLLEGE.

The present time offers an excellent opportunity for observations of Venus, which is now evening star, and may be seen for some time after sunset. The planet is daily approaching the earth, and increasing in brilliancy

With the exception of Mercury, no other planet presents as great a variety of phases, but Mercury's diameter is not much more than three-eighths that of Venus, and on account of Mercury's greater distance from the earth at inferior conjunction, the apparent diameter is not as variable as that of the more brilliant planet. While Mercury is rarely seen, owing to his proximity to the sun, Venus as evening star is visible after sunset, for several months, and again for several months as morning star, she is visible before sunrise, no other planet approaching as near the earth.

Fig. 1.—APPARENT DIAMETERS OF VENUS AT CONJUNCTIONS OF 1908, 1910 AND 1911.

The mean distance between the earth and Venus at inferior conjunction is about twenty-six million miles, with a variation mainly dependent upon the position of the earth in its orbit. The eccentricity of the orbit of Venus is less than that of any other planet, and is barely visible in the plot. It is less than one-third of e, the linear eccentricity of the earth's orbit, which is a little over one and a half million miles.

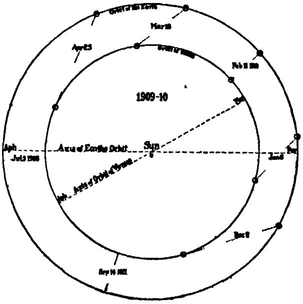
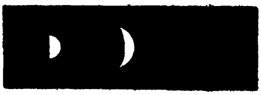


Fig 2—THE ORBITS OF VENUS AND THE EARTH

The last inferior conjunction occurred on July 5th, 1908, when the earth was near aphelion, and the distance between the planets was very nearly twenty-seven million miles. The next inferior conjunction will occur on February 11th, 1910, when the distance will be reduced to twenty-five and one-third million miles. The interval between inferior conjunctions is about one year and seven months. That of 1911 will occur on September 14th, when the distance between the earth and Venus will be nearly twenty-six and a third million miles. These distances correspond with those shown in the plot of the orbits, and the difference between them is apparent even in a drawing which is made to a scale small enough to bring it within the limits of this page. The effect of this variation of distance in changing the apparent diameter of Venus is shown in Fig. 1, which represents the planet magnified as it would appear projected on the sun's disk at the time of a transit. Its apparent diameter is inversely proportional to its distance from the earth. At the date of the approaching conjunction (February 11th, 1910) the planet will be very much nearer the earth than at either the preceding or succeeding conjunctions.



Dec. 2. Jan. 6. Feb. 11.

Fig 3.—PHASES OF THE PLANET VENUS.

Fig. 3 shows Venus at the date of the greatest elongation from the sun (December 2nd) when the half-moon phase is presented, and at the date of greatest brilliancy (January 6th, 1910) which is the crescent phase. In order to show the rapidity with which the apparent diameter increases as Venus approaches the earth during the months of December and January, the outline of the planet is faintly traced as it would appear, were it possible to see it on February 11th.

Fig. 3 inverted gives the phases which will be repeated after conjunction, when Venus will be morning star The dates of greatest brilliancy and of greatest elongation are respectively March 18th and April 23rd, and the apparent diameters will not differ much from those of January 6th and December 2nd.

It should be noted that prior to the date of the greatest eastern elongation, and subsequent to that of the greatest western elongation, Venus presents the gibbous phase, that is, while the apparent diameter is diminished, more than one-half of the visible surface is illuminated.

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Word Blindness.

It is scarcely open to question that all education should be individual, but unfortunately this requirement cannot be met in our crowded schools. The State is compelled to require a definite amount of knowledge from all engaged in the same course. The difficulties to which this may give rise are illustrated by the following stories of pupils, who despite earnest endeavor could never learn to write correctly, or to read fluently, or to pass the examinations provided for the lowest classes, although some of them are able to accomplish important scientific work. A perfectly healthy fifteen-year-old girl, one of the best pupils of the highest class of a German school, could not spell correctly either German or foreign words, either from dictation or from memory She could write single characters perfectly, she could also read a single series of musical notes, and play the violin by note, but she could not read piano music. The difficulty was that she was unable to impress the picture of the word on her memory. By the employment of a great number of aids to memory she succeeded in making much progress, but she continued to make the most incredible errors in writing, which sharply contrasted with the general excellence of her work at school. She could not read fluently, because the image of the word was not present to her memory.

The girl's grandmother, a highly-educated woman, her great-uncle, and a son of the latter exhibited the same defects. Each of the men wrote a number of scientific works, but the spelling had to be corrected by others.

In this case, therefore, this same defect, which the English call "word blindness," appeared in four members of one family. As we know that the brain contains a special center for the memory of words, we must conclude that the entire absence of this elementary faculty in persons otherwise of good mental equipment, must be caused by a defect of this small part of the brain. As such persons cannot satisfy the requirements exacted in the lowest classes, they are in danger of never reaching the higher ones. In London, one case of word blindness was found among each two thousand school children With proper appreciation of the conditions, it should be possible to carry on the education of such a child if otherwise intelligent. This, however, cannot be done by the school, it must be accomplished by the parents or by benevolent societies.—Umschau

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To Our Subscribers.

We are at the close of another year—the sixty-fifth of the SCIENTIFIC AMERICAN'S life. Since the subscription of many a subscriber expires, it will not be amiss to call attention to the fact that the sending of the paper will be discontinued if the subscription be not renewed. In order to avoid any interruption in the receipt of the paper, subscriptions should be renewed before the publication of the first issue of the new year To those who are not familiar with the SUPPLEMENT, a word may not be out of place. The SUPPLEMENT contains articles too long for insertion in the SCIENTIFIC AMERICAN, as well as translations from foreign periodicals, the information contained in which would otherwise be inaccessible. By taking the SCIENTIFIC AMERICAN and SUPPLEMENT the subscriber receives the benefit of a reduction in the subscription price.

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The trials of the new German improved "Dreadnought" "Westfalen" in the North Sea are stated to have been highly satisfactory. She developed 24,000 horse-power and attained a speed of 20 knots, compared with the 20,000 horse-power and 19-knots stipulated for in the contract with the Weser yard.

Correspondence.

THE FARCE OF OUR MILITARY MANEUVERS.

To the Editor of the SCIENTIFIC AMERICAN:

The results of the recent Boston maneuvers led an enthusiastic militiaman to inquire, "What's the matter with the militia?" As far as I know, an answer has never been attempted

The writer participated as a regular officer in the Manassas maneuvers of 1904, and later served in the New York State troops. He has had occasion to view military maneuvers both from the standpoint of a regular and from that of a militiaman. In other words, he has maneuvered on a full stomach when physically fit, and when the work imposed upon him was little more than that which regularly befell his command, and he has taken part in military encampments when fresh from an office desk, unhardened to tramping, exposure to sun, rain, heat and cold, and the coarse, half-cooked food at which his stomach revolted.

Field instruction as now imparted consists of a senseless, unnecessary physical tax upon the health and strength of our militia. Nothing but the enthusiasm, the nerve, the gameness, of our citizen soldiers enable them to stand up under the work required of them, and enable them to perform duties which no regular officer would expect or require of his men, seasoned and hardened as they are, unless matters of the gravest import were at stake. In fact, I doubt if even the splendid discipline of our finest troops could stand such a test, for men experienced in military matters know that empty stomachs are not easy to reason with, and they certainly do not prompt blind obedience.

The armory affords but one form of instruction, and that form should be perfected as nearly as possible, and too much interest cannot be created in the organization, in order that the necessary tedium of drill may not drive the men away The day of tin soldiery, of strutting about in feathers and gaudy colors, has passed.

The fault then, as I see it, is not with the militia nor the present system of armory training, which does well enough. The fault lies in the system of field instruction, as conducted by the War Department of the United States of America.

No one denies that maneuvers when properly conducted afford splendid training for the troops engaged therein, for any large assemblage of troops is certain to yield valuable experience to men as well as officers But there are many ways of conducting maneuvers, and the wrong way is the one people find fault with.

Thoroughbred colts, however carefully bred for speed, require hard training and severe work to win on the track, but do trainers take likely animals and gallop them under great weight until every limb of their bodies aches, until their backs, unaccustomed to the saddle, blister and gall, until they become foot-sore and fall from exhaustion? Are these colts then dragged to strange quarters, exposed to the elements, and fed on sour corn and ill-prepared food? No. Their food is carefully prepared, and they are comfortably housed. It is only after they are seasoned that serious work is imposed upon them, and that great exertion is exacted of them They are but animals after all. They are creatures of flesh and blood, and there is a limit to their endurance. And so is the poor militiaman an animal of limited strength, though this fact has been lost sight of on the occasions known as "military maneuvers." The fact remains as true now, however, after the Manassas and Boston affairs, as it did before, for our War Department cannot change nature, nor can it reasonably hope to make a nation of seasoned war material by periodically overtaxing and maltreating a handful of citizens, who in their military zeal crowd up to the sacrifice of the maneuvers.

Did I say that these men were maltreated? Well, they are, for I have seen them with my own eyes trudging over the heaviest roads, weak and worn, with tender, bleeding feet bound with their handkerchiefs, while the relentless sun beat down upon their dizzy heads. I have seen them sweltering in stale clothes that stunk with the sweat of days, and no provision made to give them a change of clothing. I have seen them crawl like filthy animals from under insufficient covering to take up the labors of an endless day, filling their stomachs with ginger pop and doughnuts, while the nearby regulars, warm and dry, breakfasted on good hot coffee, bacon, hash, and bread Is it not pitiful to think that these poor fellows are misled into believing that such is the life of a soldier?

How can men under such conditions profit by the object lesson intended for them? The events, in which they play a sad part, are as non-understandable to these poor militiamen as ignorance and folly can make them. They flit through their weakened minds like troublous dreams. A waking dream it is, however, for seldom is the citizen soldier allowed to drown his troubles in sleep, to recoup his depleted strength in repose. The night alarm, the dance of guard duty, the din of the camp added to by numberless officers who rate their ability by the amount of noise they can make, render sleep a foreigner to the militia camp.

Such, then, are some of the conditions which repeat themselves maneuver after maneuver. Much thought and time are spent on plans of attack, on entraining and detraining the troops, on testing the water supply and inspecting pits, but having lured the guardsman to the camp, little time is spent on his personal instruction.

He is taught not to shoot at his friends with real charges, and asked to march, march, march, day and night without food, without rest, without the slightest attention to bodily cleanliness, all of which are fundamental in the preservation of health and sanitary conditions.

Having criticised and condemned the present method of conducting maneuvers, it is only fair to answer the question, How can the militia be really benefited by field maneuvers?

In the first place, the time usually allotted is absolutely insufficient to permit of any real benefit to the militia, for the militiaman is not physically fit to stand the work of field movements on a large scale. Before such exertions are required of them, they should have at least a week or ten days to accustom themselves to camp fare and field conditions, to learn to make themselves comfortable in camp and bivouac, to toughen themselves gradually With each command of militia should be camped enough regular troops to supply each militia company with a competent cook, to instruct the men in the preparation of their rations To each company should be detailed several regulars, to instruct the men in tent pitching, camp police, how to keep themselves and their equipment clean, how to make comfortable pallets on hard ground, how to secure rest at night, in matters of camp sanitation and numberless other things which experienced soldiers regard as necessary Such instructions would indeed be valuable, for these are things which are not to be learned in the armory

For the first week or ten days in camp, tedious drills and ceremonies should be dispensed with, and instead the men should be given light exercise in the form of short marches during the cool of the day, so as to allow them to adjust their packs, break in their shoes, and harden their feet to marching Upon returning from such marches, they should be required to wash themselves and change clothing, and then be allowed to rest. Dress parades, reviews, and such displays should be dispensed with. They do not instruct the men After the machinery of the camp is in good working order, and the quartermasters and commissaries have distributed their supplies, after the sore feet and weaklings have been weeded out, night attacks, forced marches, picket duty, etc., may be indulged in with some advantage to the field officers at least, and without very great punishment to the men of their command The men will by this time be in a physical condition which will permit of discipline, and will not be broken down and demoralized, so that they will go home utterly exhausted, and with the idea firmly rooted in their minds that the mobilization of a large body of troops means confusion and neglect of all semblance of the order and the precision which have been drilled into them by their officers at home. I may here say that my experience has been that it takes a number of drills after an encampment to get the men back in shape, so demoralized do they become under the influence of the so-called field discipline, which should be, if possible, even greater than garrison discipline.

Tactical movements as maneuvers can be instructive only to field officers and their staffs, the other participants are not in a position to follow the movement of the army as a whole Therefore, since the junior officers and men must remain necessarily in more or less ignorance concerning the movements of the army, unless something is devised for their instruction and benefit, the maneuver, so far as the great mass of participants is concerned, is a useless farce. This being so, every move and every order emanating from the commander of a maneuver army should have in view the instruction of the individuals of the army, and no move should ever be made which would sacrifice order and discipline in the ranks, even to the tactical success of the commander

Now, then, it will be said that the militiamen cannot spare the time to follow out the above plan, that they cannot neglect their business, upon which they depend for a living; and that to require the militia to spend two or three weeks now and then in camp, would be to set up requirements which would discourage enlistment in the State organizations. This is an old argument, and apparently has some weight, but upon investigation it will be found that the average militiaman, under present methods, is rendered unfit for effective work for a much longer period than that actively spent in camp. Some of them, poor fellows, never return to work. Many more go to the hospitals and to their sick beds for weeks, and the demoralization of mind, due to utter exhaustion of the body, renders the majority of the remainder unfit for work for varying periods of time.

But suppose the militia could not be mobilized for two weeks, or better still, a month, every second year, so as to throw an encampment in every man's enlistment, is it not better to give up the present farcical, cruel, and demoralizing system of maneuvers, than to subject the militia to such senseless physical tests?

Even if such methods as now employed were capable of putting our citizen soldiers in fit physical condition, would they remain so indefinitely? Would they not be soft, and again unseasoned upon the advent of war? Is not the fact that our militia is demoralized and unfit for the slightest additional effort at the end of the maneuver periods ample proof that the present system is erroneous? There is but one correct answer to each of these questions and it is a crying shame for the sages of our War Department to take enthusiastic militiamen far more intelligent than the average regular soldier, eager to learn and unselfish in the devotion of their time to their State and subject them to hardships which regulars could not be expected to bear under similar circumstances.

As a regular, I have smiled and looked with scorn upon the disorganized and crippled ranks of our citizen soldiers in the maneuver field, but as a militiaman I have felt the indignities which earnest and willing men have borne in those exhausted ranks.

I say that the fault lies not with the militia far from perfect as it is, but with our War Department and those who conduct the field maneuvers. If their judgment were as faultless as the enthusiasm and willingness of the average militiaman is great, much good would result from field instruction

JENNINGS C WISE.

An American Demonstration of the Urban-Smith Process of Animated Color Photography

The evening of December 11th a demonstration was given in the concert hall of Madison Square Garden, New York city, of a new process of moving pictures in natural colors, which has been perfected during the last two years by Mr G Albert Smith of London, England A large audience was entertained for two hours with a considerable number of kinematograph views in natural colors These pictures besides being excellent reproductions of the original subjects both as to shade and color, were not so tiring to the eyes as the ordinary moving pictures, due probably to two reasons, viz, double the number of pictures thrown upon the screen, thirty-two in a second and the toning down of the light by the color screens

The new process is a modification of the Friesse-Greene process illustrated in the issue of this journal of October 9th last Instead of using three color screens—red green, and blue—in connection with two films, as does this inventor, Messrs. Urban and Smith have combined the blue and the green into a single blue-green screen One-half the pictures are taken through a red screen, and the other half through this blue-green screen The screens, of colored gelatine, are arranged so that each forms half of a revolving disk placed in front of the lens. The pictures are taken on a specially prepared film made panchromatic by means of suitable dyes. As a result of this there is scarcely any difference in the density of the two images made through the different color screens. A positive is made from the negative upon ordinary film When this is projected through the colored screens—each picture of course being projected through the same colored screen as that through which it was taken—the spectator sees the view in its natural colors, since the eye retains the color impression of the red, for example while the blue-green picture is being substituted for it and after the latter is in its place. The combination of these two colors produces white light in much the same way as three colors do this with the Ives process. The single film and single revolving screen in front of the lens is a great simplification of the Friesse-Greene two film process The pictures can be made with an ordinary machine with but few changes. The subjects shown varied widely, extending from flowers to animals and birds harvest scenes, military reviews waterfalls and surf etc. In all of these pictures the coloring was excellent and altogether true to nature Such colored pictures have been shown for some time in several large music halls abroad and they will soon be produced no doubt, in similar places in this country

◆

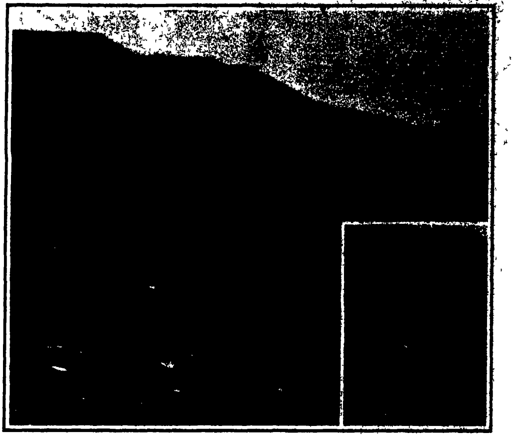
A sliding embankment on the Pennsylvania lines west of Pittsburg near Dinsmore Pa which had given trouble for some years, was remedied at a time when a new culvert was put through it by driving two small tunnels entirely through the embankment and filling them with riprap. The embankment is 30 feet high and is on a sharp curve on a hillside having a slope of 20 deg., down the face of which runs a small stream When the tunnels pierced the core of the embankment water gushed out for several hours in a stream large enough to fill a 12 inch pipe These tunnels keep the embankment drained, and no trouble has occurred.

AN AERIAL PASSENGER RAILWAY.

BY ROLAND ASHFORD PHILLIPS.

It is as easy now to ride in a bucket from the base to the very summit of the loftiest mountain chain in the Rockies, as to trolley across Brooklyn Bridge.

The station, showing the cables leaving the drum.



The bucket has just left the power house. An empty bucket is seen coming back.

To take this wonderful ride on the Sunrise Peak road, you leave Silver Plume and walk a few blocks to the aerial station Under this cover you wait for your bucket As it swoops down and stops, you step into it The man shuts the door and locks it secure A bell clangs, and you are off. The bucket swings away, and you hold tightly to the iron rim. The little depot with its crowd slips away below You look around. There are no confining walls—nothing but clear Colorado air Your sensations are comparable with those of a balloonist.

You begin to gather a bit more courage You look around. There to your right are towering cliffs, a dozen times as lofty and as massive as the tallest skyscraper In another direction are deep cañons, rocky gorges, and steep, verdant slopes. Still you go up Sometimes you clip the swaying tips of a monster primeval pine tree and again you are swaying over an all but bottomless cañon Then a broad green valley slips along below you, colored with myriads of wild flowers Now marked like some gigantic belt, comes the timber line The flowers give way to stunted brush and barren stretches of dull rock. And both of these in turn are soon hid from view by [illegible] ing half hour in [illegible]. The bucket stops, and you step out upon the cold, snow-clad summit of the peak. At intervals fleecy clouds drift across your vision, blotting out the valley below.

You have gone to the sky in a bucket, you are standing above the clouds, two and one-half miles higher than New York city

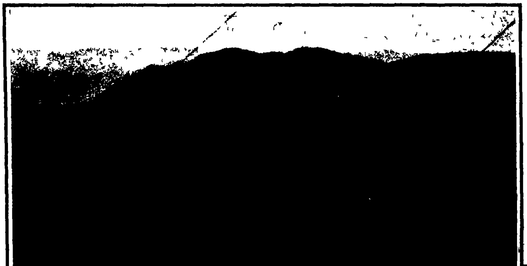
When the clouds clear away, you note the filmy line of cables stretching down, from tower to tower not unlike the silken web of some gigantic spider, swaying in the sunlight, finally to dip over a ragged shoulder of a ridge and disappear

The idea of these traveling buckets is by no means new particularly to readers of this journal, since the identical principle is in use throughout the mining world as a means of transporting ore from the mines to the mills. In some instances these are worked by gravity, and in others by motive power

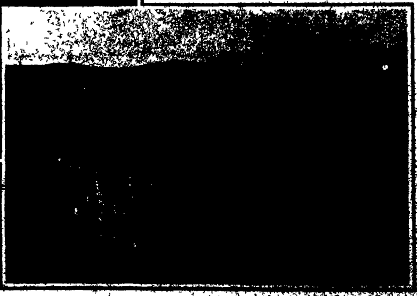
It remained however for a western engineer to utilize this system of carriers, not for business but for pleasure For a good many years Sunrise Peak was a noted attraction for the tourist, but all methods of reaching its lofty summit were crude indeed Confident of his success, the engineer interested a few wealthy men The aerial railroad is the result. In Italy this method of transportation is largely in favor, especially across bodies of water, but the Sunrise Peak line is the only one in America.

There are two main cables, the stationary and the

(*Continued on page 496.*)



This picture was taken about half way to the summit. Silver Plume looms in the distance The wagon road is seen winding up into the hills; also the creek, down the cañon of which the railway runs which connects with Denver



At the summit, Sunrise Peak, high above the clouds. [illegible]

AN AERIAL PASSENGER RAILWAY.

HOW YOUR EYEGLASSES ARE MADE.

BY C. H. CLAUDY.

No man ever had but one pair of eyes. Most men value them above all other senses. Yet is a man often careless of his eyes, neglecting the visit to the optician and the glasses which may improve and prolong his sight, and ninety-nine out of a hundred of him never think or ask, "Am I getting the best-made lens the market affords?" He takes what the optician gives him on faith. The hundredth man goes through a spectacle lens factory, and forever after he is extremely particular about his glasses. He finds out how difficult and how delicate an operation lens-grinding is. He knows how easy it would be to make an error.

First he sees the imported blank pieces of glass sorted by machinery before being ground—for greater accuracy Then he watches a workman attaching them with pitch to "blocks" and "shells," concave or convex pieces of iron of exact curvature, which are revolved in their mates with abrasive, to do the grinding. He notices that the more powerful the lens is to be, the smaller the shell and block, and the less the number of blanks it will accommodate. Hence the increase in price of strong lenses over weak ones. Wandering through the labyrinthian corridors in the basement of a great factory, and seeing the thousands and thousands of pairs of shells and blocks used for spectacle-lens grinding alone, he stops to wonder at the science and the knowledge which devised this enormous number of possible curvatures Here glass working and metal working join hands. The alliance is vital, since the curve of the lens depends on the curve of the shell and block, the perfection of which means the perfection of the original lathe.

The sightseer may walk through aisle after aisle of room after room, filled, in long, long ranks, with hundreds of grinding machines. He will see machine tenders, each with his set of machines to watch, keeping each set of lenses supplied with abrasive, changing blocks and shells from the rough grinders to the second grinders, from the second grinders to the fine grinders, and from the fine grinders to the polishing machines, where felt, carefully mounted on block or shell of proper curvature, and rouge, take the place of iron and emery, working out the last tiny abrasive mark and leaving the lens with a highly glossy surface, perfectly polished. He will watch the "picker" detaching lenses from the pitch with a pointed tool and may perhaps ask to try it (it looks so easy) and may well break up several dollars' worth of lenses in attempting to imitate the skillful movements of the trained workman. He will watch the reblocking of the lenses, this time in the shell, or upon another block, if the lens is a double convex, see the whole range of operations repeated, and note the even greater care taken now, for it is no longer *only* glass which is being ground, but a partly finished lens, the cost of which has far exceeded the first cost of the raw materials. But he will not be able to watch any individual lens through all of its operations. Clock hands mark four and one-half hours for each of the rough, second, and fine grindings, and as long for polishing—more than two days to complete any one lens. Cylindrical lenses require even longer—five hours for each grinding and seven for the polishing

There is something uncanny about the grinding machines. To grind any glass evenly and truly requires more than one movement. While the shell or block revolves the axis of the companion fitting it nutates back and forth and revolves also, so that each lens continually changes its angle with the grinding or polishing surface With the cylindrical grinding machines there is no revolution of the grinding surface, but a constant shifting back and forth which accomplishes the same purpose One machine would not impress, ten would hardly get a curious stare but thousands and thousands, all nodding and bowing, certainly command attention

The visitor will hear something about the names and kinds of spectacle lenses. For instance a periscopic lens is a meniscus, or a convexo-concave lens. Periscopic means "all seeing," and the use of this form in eyeglasses not only gives the eyes a wider angle of view than does the plano lens, but better accommodates the sweep of eyelashes, decreases reflections from behind and when the periscopic curve is deep, maintains all parts of the lens as nearly as possible equidistant from the pupil of the eye, no matter in which direction the eye itself be turned

The ordinary two-curve or sphero-cylinder lens used for the correction of hypermetropia or myopia and astigmatism at the same time having one side of the lens ground to the section of a cylinder and the other side to the section of a sphere obviously cannot be made periscopic if the spherical curve be convex, nor deeply periscopic if the spherical curve be concave Yet the advantages of a deep periscopic glass are as great with the sphero-cylinder lens as with any other

How is the problem solved? The solution was known long ago—the toric lens—but only recently has its successful manufacture been possible A spherical lens has the same curvature measured in any meridian A cylindrical lens has no curvature in one meridian, and its greatest curvature in the meridian at right angles to the first

A sphero-cylindrical lens has a spherical curve on one side and a cylindrical curve on the other A toric lens is one having two different degrees of curvature in two meridians at right angles to each other on the same side of the glass. These two curvatures have the effect of a sphero-cylindrical

Fig. 1.—Fine grinding of a pair of eyeglass lenses.

Fig. 2.—Lenses cut but outer rim not broken off.

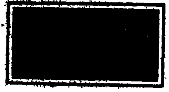


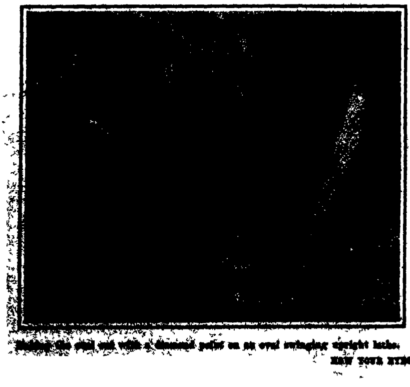
Fig. 3.—Centered lenses, showing center mark and reflection of this mark below it.

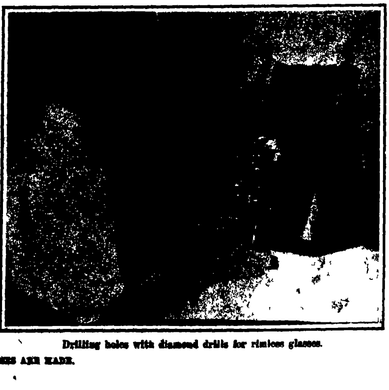
Fig 4.—Polished and edged lenses of a pair of eyeglasses.

Fig. 5.—Lenses entirely finished, drilled, edged, and ready for the stock room.

Fig 6 Improperly polished lenses, the black spot and band showing portion which has remained rough

Centering the lens. This operation is highly important; for on the ink spot placed on the center of the lens depend the mechanical and optical properties of the finished lens.


[illegible] the [illegible] out with a diamond point on an oval swinging upright lathe.


Drilling holes with diamond drills for rimless glasses.

HOW YOUR EYEGLASSES ARE MADE.

lens. The difficulties of the manufacture of toric lenses are enormous, as may be imagined, requiring special machinery to grind two curves at once on one side of one piece of glass. Only in recent years have such lenses been commercially possible. These grinding machines have meant the expenditure of thousands and thousands of dollars and of years and years of time.

Ground, the lenses go to the cleaning room, where, in wooden trays, they are soused and soused again in ten different baths, acid and water, and alkali and water, and soap and water, and repeat. Finally they are plunged in a bath of rouge, which leaves the wooden trays dyed the familiar red of the optical factory, and with a film of rouge on each glass for the final hand polishing and cleaning

So far the glass has been merely glass, raw material in various stages of manufacture. Now it is a lens. Before it goes further in the tedious costly process of making raw glass into an aid to eye sight, it is rigidly inspected

Inspection is for striæ (streaks), for air bubbles, for picker's scratches, for grinding scratches, for failure to "polish out," for too great thickness or thinness, for cracks, for breaks, for nicks, and for "target polishing," or polishing in rings. The girls who inspect for defects and for quality, who decide whether a lens is of first quality or not, become extremely expert. They see things in an instant which you may not be able to see even when pointed out Every sphoro-cylinder or cylinder lens must cut a circle thirty nine millimeters. Its axis can then be ground at any angle for a normal eye. Larger lenses are supplied on order In the spherical glasses the inspection test must not show any defect within an oval thirty-nine by thirty millimeters, nor any serious defect, such as chip or striæ, beyond that size.

After inspection, a series of operations, bewildering in the dexterity with which they are accomplished, the lens is centered A girl fits the glass on the centering instrument, takes a swift look through an eyepiece, sees that a cross hair behind the eyeglass and a cross hair behind the eyepiece of her instrument are in line, and "click," a little ink-spotted pointer has touched the center of the lens, the optical center If the lens has a cylindrical curve, and consequently a major axis three ink spots are made upon it, one for the optical center and one at each end to show the axis.

For axial determination, the instrument is accurate to within one-half a degree The lenses are gaged for thickness, and sorted to size, and then gaged and sorted for actual area. lenses are "two eye," "one eye" "0 eye," "00," "000," "0000 eye," and finally "jumbo" in size, and each must be gaged to see what size it will cut.

Spherical lenses are usually finished at the factory, edge-ground and packed ready for use, and, since a spherical lens has no axis, it can be cut with the long axis of the oval in any direction to the shape of the ground and polished blank But the cylindrical lens, the sphoro-cylinder, or the toric, must be left unfinished as to edge, except for special order, since the angle the axis of the cylinder curve is to make with the astigmatic eye is important.

If the lens is to be edge-ground, the next operator upon it fits the lens over a size gage upon the table of a little machine, turns a handle, and behold, a tiny diamond cutter has oval ringed the glass with a scratch the shape of the finished lens. Another girl breaks off the rough edges with pliers and, perhaps a rough pair of iron shears. To see her surrounded with splinters and tiny spikes of glass all over her lap and bench, you would imagine she was in imminent danger of injury, but cuts are rare even with the thickest and heaviest of lenses.

For rimless eyeglasses or spectacles the lens must have holes drilled in it. It goes to a girl with a drilling machine and diamond-pointed drills. As the tough material is bored, a steady stream of cleanly odorous camphorated turpentine plays upon the glass and the drill, and the little automatic machines, each with its impassive feminine watcher, turn out lens after lens with one or two tiny smooth-edged holes at the ends, ready for the next operation

More washing and cleaning follow, and then edge grinding, a matter of wonderfully ingenious machinery, by which the rough-chipped edges are made smooth and the lens, so far as working the glass is concerned, is finished

Then this product of many operations is focused, much as the elements of a photographic lens are focused, by a girl with a special focusing camera, wiped again, packed, labeled, and stocked. Two hundred and twenty-five gross pairs, or sixty-three thousand lenses, are so finished every day in one big factory

Nearly a million pounds of optical glass are made into eyeglasses in this one factory every year. It takes thirty tons of emery to grind, and twenty tons of rouge to polish this product. It requires five thousand yards of toweling every year to wipe it clean. For every unedged lens, there are forty-nine operations, for every edged lens, sixty-eight operations. A spectacle lens is simple to look at, but after you have visited the factory, you will know it for what it is—a very complex thing.

FLIGHT WITH FLAPPING WINGS.

Human flight by flapping wings is impossible for several reasons, chief among which is that Nature has failed to furnish us with the anatomy or the muscular strength which are necessary for flight of this kind

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Rear view showing the wing framing and the tail.

It is evident that the motive power for the machine herewith illustrated is to be furnished by the arms of the operator, and the movements when the body was in horizontal flight, would consist of a vertical oscillatory movement of the arms when stretched to their full extent. The power for lifting and propelling the man and the machine, whose weight would be at least two hundred pounds, would therefore have to be furnished entirely by certain muscles of the chest and shoulders, which are rarely brought into strenuous use, and are feeble compared with other muscles of the body

Furthermore, with the slow rate of oscillation of the wings of which a man would be capable, their area would have to be very large, and their weight would of course increase rapidly in proportion. Prof. Langley pointed out that the difficulty of flying with flapping wings increases rapidly with the increase in size and weight, this being due to the mathematical law that the area in bodies increases as the square of their dimensions, while their weight increases as the cube. He pointed out that "the larger the creature or machine, the less the relative area of support may be (that is if we consider the mathematical relationship, without reference to the question whether this diminished support is actually physically sufficient or not), so that we soon reach a condition where we cannot imagine flight possible. Thus, if in a soaring bird, which we may suppose to weigh 2 pounds, we should find that it had 2 square feet of surface, or a rate of a foot to a pound, it would follow from the law just stated that in a soaring bird of twice the dimensions we would have a weight of 16 pounds and an area of 8 square feet, or only half a square foot of supporting surface to the pound of weight, and if flight is possible in the first case, it would appear to be highly improbable in the second. The difficulty grows greater as we increase the size, for when we have a creature of three times the dimensions we shall have twenty-seven times the weight and only nine times the sustaining surface, which is but one-third of a foot to a pound. This is a consequence of a mathematical law, from which it would appear to follow that we cannot have a flying creature much greater than a limit of area like the condor, unless endued with extraordinary strength of wing."

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The frame is of aluminium and covered with balloon cloth. There is no motor. The designer hopes to fly by man power.

FLIGHT WITH FLAPPING WINGS.

To fly with the machine herewith illustrated would call for an expenditure of horse-power far beyond that which the strongest man on record ever possessed. It is doubtful if the average man is capable of exerting more than a quarter to a third of a horse-power continuously. It is true that, in supreme moments of effort, and for a very brief period, athletes may exert as high as one horse-power or a little over. The motorless aeroplane, or glider, is the only successful medium of human flight. Flapping wings are clumsy, difficult to construct, uneconomical in operation, and, according to present knowledge and experience in the subject, they form a wholly impossible means of human flight.

Depth of the Gulf Stream.

In Lieut. Pillsbury's examination of the Gulf Stream at various points from Hatteras southward, he found that the stream reaches to the very bottom in some places and tabulated its velocity at different depths. His results, as well as a review of the whole field of Gulf Stream investigation, are found in appendix 10, report for 1890, of the United States Coast and Geodetic Survey. It must not be inferred from the foregoing that all ocean currents extend to the bottom of the sea. Many instances are at hand of ocean currents extending to great depths. For example, Admiral Erminger, of the Danish navy, found that the northwesterly current in latitude 25 deg. 04 min. N., longitude 65 deg. 41 min. W., prevailed to a depth of 290 meters; Commander John R. Bartlett, United States navy, found a current in the Windward Passage to the depth of more than 800 fathoms (1,460 meters), and concluded that it reached to the bottom, between Key West and Havana the stream was measured in 1860 to a depth of 600 fathoms (nearly 1,100 meters), and was found to be only 10 per cent less than at the surface.

It is well established that the Gulf Stream loses in depth, temperature, and velocity, and gains in width, especially after passing Cape Hatteras, until the 40th meridian it becomes a drift current, reinforced on its right flank by the powerful Bahama current. Various measurements for temperature show that the Gulf Stream is shallower than its northeastern extension beyond the 40th meridian. Thus Commander Chimmo, R. N., commanding H. B. M. S. "Gannet," during the summer of 1868, found the warm water of the Gulf Stream to be less than 50 fathoms deep in latitude 44 deg. 03 min. N., longitude 48 deg. 07 min. W Ten degrees to the eastward the warm water had deepened to 100 fathoms or more and in latitude 43 deg. 48 min. N., longitude 37 deg. 47 min. W, the warm water was found to extend down about 250 fathoms. Observations made on board H. B. M S. "Porcupine," during the summer of 1869, showed remarkable depths in the Gulf Stream drift, as follows: In latitude 59 deg. 35 min. N., longitude 9 deg. 11 min. W., the warm water was found to extend to the very bottom of the sea, 767 fathoms (1,409 meters); at Rockall the warm drift was found to reach down 900 fathoms below the surface, and similarly again in latitude 47 deg. 38 min. N., longitude 12 deg. 08 min. W. At the last-mentioned observation spots the warm water was found to be underrun by a polar current at depths of more than 900 fathoms. A similar phenomenon is often observed near the Grand Banks where the Labrador current dips under the Gulf Stream at comparatively shallow depths, 50 to 100 fathoms.

Daniel's Comet.

The comet discovered by Mr. Daniel of Princeton Observatory has received considerable attention throughout the country. Dr. H. C. Wilson of the Goodsell Observatory, and Prof. E. B. Frost, Director of Yerkes Observatory, have both sent communications on the subject to Harvard College Observatory. Furthermore, Dr Ebell of Kiel has computed an ephemeris. From the photograph which has been made at Yerkes Observatory it seems that the comet has no stellar nucleus; a short tail is suspected.

THE BABY MUSK OX AND THE ALASKAN BEAR OF THE NEW YORK ZOOLOGICAL GARDENS.

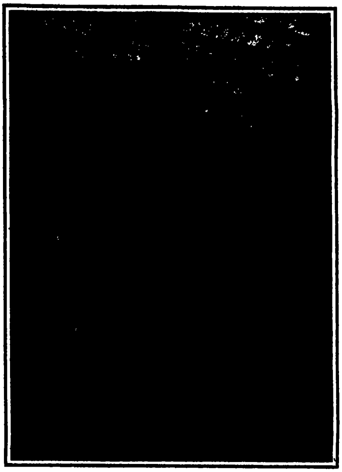
BY WALTER L. BEASLEY.

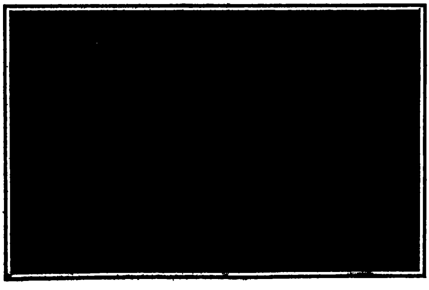
Through the efforts of Director W. T. Hornaday of the New York Zoological Society, New York has acquired two most interesting new animals—one a baby musk ox, and the other a giant Alaskan brown bear

Although the musk ox is a typical polar animal, this is perhaps the only specimen to be found in captivity Whether our climate will so far affect the animal's health that it will perish, remains to be seen. This particular specimen was captured on Melville Island, six thousand miles from the Zoo. The price paid was $700. The animal is about six months old, and in splendid physical condition. The entire body is covered with a dense mass of fine brown wool. Across the forehead is a broad band of white, and on the back a light gray saddle mark. A thick mass of wool hides the short horns. In time these horns will grow until they meet at the center of the forehead. When fully grown the whole top of the head will be covered by a pair of horns considerably flattened at the base, meeting in the center of the forehead, thence sweeping downward over the edge of the cranium, close to the cheeks, and finally recurving upward before coming to a point. The animal illustrated is about 3 feet long, nearly 2½ feet in height, is about half grown, weighing 190 pounds. A full-size adult male stands 4 feet 5 inches high at the shoulders and is 6 feet 7 inches in length, weighing about 1,200 pounds. The species shown in our photographs, from the marked characteristic of the large whitish patch on the face and saddle mark on the back, has been named by Mr R. Lydekker, of the British Museum, *Ovibos Moschatus* Wardi, in honor of Mr Howland Ward, the natural history dealer of Piccadilly, London, from two types of a mounted male and female from East Greenland, in his possession. The other form or species of the musk ox, *Ovibos Moschatus*, is confined mainly to the Arctic Barren Ground regions east of the Mackenzie River, and formerly thought to have had a continuous distribution westward across Alaska.

Of the 5,520 living animals in the New York Zoological Park, one of the most remarkable is the great Alaskan brown bear Ivan. This colossal animal belongs to the species *Ursus dalligyas* Merriam, and was captured at Moeller Bay, Alaska Peninsula.

The writer was able to obtain a very striking picture of the giant Ivan, standing seven feet in the air with uplifted front paw, by venturing inside the inclosure with an attendant A tempting fish coaxed the big animal to assume an upright pose. Ivan recently gave a practical exhibition of his astonishing strength and vigor by tearing out a panel of the heavy steel bars that separate his quarters from those adjoining and engaging in a fierce battle with a hated rival. In ten minutes the monster bear wrenched and trampled down the barricade of steel bars as if they had been made of reeds. It would have taken six men an hour with block and tackle, sledge hammers, etc., to have accomplished such a damage. The enraged giant fought with his antagonist until finally clubbed off by the keepers. Ivan's long shining and shaggy brown coat converted into a rug would be worth nearly one thousand dollars. Ivan is one of the few living examples of the fast disappearing species of the giant brown bears of America in captivity, a species especially interesting as possessing some very extraordinary, intelligent habits. In his distant Alaskan home Ivan practised the art of salmon fishing. As soon as the salmon begin to enter the streams in July, from the sea, big brown bears of his species make fishing their chief business. Both the old male and female fish for salmon in order to furnish a plentiful supply to satisfy their own enormous appetites and those of their young. The cubs do not attempt to fish, but stay on the bank and receive contributions tossed up by one of the parents. The she-bear stands upright, and wades in water even up to her neck, going very slowly with the current, watching the water, and scarcely making a ripple in it. She holds her arms down at her sides with hands or paws spread, and when she feels a salmon coming up against her, quickly clutches it with her paws, and throws it out on the bank to the expectant cubs. After supplying the cubs she tosses up a pile for herself. The last fish she puts in her mouth, and goes ashore to enjoy her feast.


IVAN, THE GREAT ALASKAN BROWN BEAR OF THE NEW YORK ZOO


THE NEW BABY MUSK OX OF THE NEW YORK ZOO.

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Artificial Petroleum.

The origin of petroleum is still an object of much dispute among savants, some attribute it to inorganic sources, others to organic In America there is an inclination toward the latter solution of the problem, at least so far as concerns the petroleum of the New World, for the layers of schist which carry it always contain the *débris* of diatoms, foraminiferæ, the skeletons and scales of fish, etc.

Impressed with this latter detail a savant (of whom the name is not given) has, as a result of many trials, made it seem certain that petroleum was formed by a sort of distillation of extinct sea fish. According to indications, states the Revue des Eclairages, manufacturers should collect a large number of fish and should have them distilled. They ought then, moreover, to obtain a result something like that from the following first trial

The savant then conceived the idea of mixing the fish with a large quantity of salt. The novel experiment was made tentatively, the fish were strung upon cords and brought into a large retort, where they were mixed with a quantity of sea salt, the whole, upon distillation, gave a petroleum of excellent quality, which could be used for the lighting of buoys. We have no information, unfortunately, about the economy of such a method of procedure, and do not know moreover, if the company which has made this trial has been able to continue with success which justifies commercial development.

We confess that we are a little skeptical regarding this novelty It may well be that there was obtained by this procedure an oil capable of burning, that may be granted but was it petroleum? It might be well to preserve this idea, which would be of some use when the natural suply of petroleum is exhausted

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The Current Supplement.

"How Sponges Are Gathered and Artificially Grown is the title of an article by Newton Forest which opens the current SUPPLEMENT No 1773 Mr R M Strong's excellent comparison of gasoline and alcohol engines is continued The first experiments made in aviation were desultory, and were made without the help of any well established rules Hence it is that the fundamental principles and mechanical properties of fluids were not as well [illegible] as they should be To [illegible] institutions have been established in Europe for the express purpose of obtaining a really scientific knowledge of the air and propellers and plane surfaces One of these institutions is described C G Derrick reviews the methods in current use for waterproofing concrete structures Capt. A C. Knowles writes on the Army Signal School and its work. Whether the wax bust purchased by Dr Wilhelm Bode for the Kaiser Friedrich Museum at Berlin is really the work of Leonardo da Vinci as is claimed or of a modern craftsman, is discussed The evidence *pro* and *con* is impartially given Under the striking title "The Blood of Plants' Mr Victor Graef writes on some modern botanical researches The reappearance of Halley's comet renders particularly timely Mr Arthur Stanley Eddington's paper on light pressure and comets tails Dr Alfred Gradenwitz contributes an excellent article on wireless transmission of diagrams handwriting, and photographs. The startling success of Mr Louis Brennan with his gyrostatic car lends peculiar interest to an article by Mr Horace B McCabe on the principles and applications of the gyrostat

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Cooling Tower Practice.

In an article on cooling tower practice which appeared in the Electric World some little time ago the author states that tests on both open and closed types of towers, under various hygrometric conditions, have shown that, with an average range in temperature extending over several days of from 140 deg to 170 deg F., the fall in temperature obtainable has resulted in outflowing water of from 90 deg to 60 deg F with atmospheric temperatures between 55 deg and 85 deg F, and hygrometric conditions ranging from 30 to 50 per cent of normal saturation An open type tower capable of cooling from 400 to 600 gallons of water per minute as dependent upon its special construction will be roughly 20 feet by 20 feet by 40 feet or 45 feet for cubical contents and will have at least six so-called drip pans or retarding surfaces in its make-up The cost of such a tower with a capacity of 400 gallons per minute would range between $1 200 and $1,500 and in general each additional 100 gallons per minute capacity increases the cost by approximately $200 The closed type costs from three to four times that amount for installation and the additional increases range at about double the price for the open type. In cost of operation about $2 per day will be required for maintenance of the tower and for fuel and water for operation of ans pumps, etc. If water costs 6 cents per 1 000 gallons or more, the author maintains that it pays to erect the cooling tower if the total water lift does not exceed 80 feet.

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The only export tax in Mexico on minerals or mineral products is on gold and silver All other products of the mines are exported free except for a nominal customs charge at the port of export.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

COMBINED SOCK AND GARTER.—L. O. GITCHELL, New York, N. Y. This garment fastener comprises a combined sock and garter arranged to insure correct support of the sock on the leg and to allow ready closing and opening of the garter, the latter being for this purpose permanently attached to extension flaps formed integrally on the upper end of the sock at the sides thereof.

RACK.—G. H. McGREGOR, New Glasgow, Nova Scotia, Canada, and A. S. REDLAND, New York, N. Y. One object of this invention is to provide a simple and inexpensive and compactly built rack for displaying and preserving articles such as garments and the like, which can be easily taken apart and packed into a small space, and in which the articles can be protected from dust, moisture, and so forth.

Electrical Devices.

BINDING POST.—J. STEINBERGER, New York. Mr. Steinberger's invention comprehends a post having a central stem encircled by a spiral spring of metal and adjacent to the ends of this spring clamping plates arranged in pairs, the plates of each pair being pressed together by the action of the spring and the outer edges of the clamping plates being slightly curved to facilitate the entrance of the wire therebetween.

Of Interest to Farmers.

SELF-BINDER ATTACHMENT.—F. PENNINGTON, Westhope, N. D. The inventor has means for depositing the bundles of grain delivered from a self-binder in shocks while the machine is in motion. An object is to provide means whereby the bundles of grain as they are delivered from the self-binder may be held together in shock form and at the will of the operator deposited in shocks.

CORN PLANTER.—G. M. GORMAN, Anamosa, Iowa. The inventor employs a marking device for seed planters whereby the rows of hills are maintained in parallel lines and equidistant, and provides a mechanism for accurately operating the marking devices, which mechanism may be raised and lowered out of and into operative contact with the ground conjointly with the planting device.

FRAME.—L. B. STETSON, Bellevue, Wash. This invention relates more particularly to adjustable frames such as are adapted to be used in the cultivation of plants such as tomato vines and the like, and which consist of uprights adapted to be driven into the ground and having arms pivotally secured thereto, means for holding the arms extended and supports removably arranged on the arms of the uprights.

GRAIN CUTTER.—I. CLARK, Greenfield, Ind. The cutter is for use in connection with binders. The object of the inventor is to provide a combined cutter and binder whereby the grain may be bound into bundles while in upright position as it is cut from the ground. Means provide for dividing the grain as it is about to be cut and supporting said grain after it is cut in upright position and transporting it to a binder mechanism while still in the upright position.

CORN RACK.—J. S. WINTON, Milford, Iowa. In the present patent the invention is an improved rack and belongs to that class of such devices in which a number of corn ear impaling pins project from a support and sustain the ears in spaced relation and at known points during the period of curing, storing and testing.

EGG TESTER.—EVELYN LATES, Bronxville, N. Y. By this device eggs may be conveniently inspected at the outside of the usual egg testing box. The box has egg-seating openings in the top and is provided at the side with a door having a mirror on its inner face, the door being hinged to swing downwardly and outwardly to a position to reflect the light passing through the openings.

Of General Interest.

WELL-TUBING AND MEANS FOR CONNECTING SECTIONS THEREOF.—G. A. PITTMAN, Dawson, Neb. The object here is to provide a tube of any length from vitrified clay formed in sections before baking the same and also provide clamping means for joining the tube sections together endwise, thus producing a practical lining which may be placed in a well bore or removed therefrom with the same means used to insert and remove iron lining tubes.

ARTIFICIAL HAND.—W. A. HENNESSEY, Ashland, Wis. In view in this invention are the following objects: To provide means whereby the fingers of an artificial hand may be caused to fold and to grip an object to lift the same; to provide means whereby the fingers of an artificial hand may be maintained in a released position; and to simplify the construction so that the hand may be automatically operated.

DRY YEAST COMPOUND.—J. F. YOST, Arkansas City, Kan. The more particular purpose of the invention is to provide a carrier for certain yeast compounds originally prepared in the form of a liquid and afterward dried. The product consists of vegetable pith and a yeast compound, the pith being in the form of small particles and the compound being coated superficially upon the particles.

FOLDING CRATE.—F. C. MILLER, Chehalis, Wash. The object of this improvement is to provide a crate or like receptacle, having its parts arranged for convenient erection or folding into a flat package and locking the folded parts in place. It relates to crates, such as shown and described in the Letters Patent of the U. S. formerly granted to Mr. Mary.

SELF-CLOSING BOTTOM FOR WELL-STRAINERS.—J. A. POLLARD, Oakland, Miss. In the present patent the invention relates to self-closing bottoms for well strainers, which are adapted to be attached to a well-strainer of any suitable type and to be lowered into a well, together with a strainer, by means of a force pipe, the latter being afterward removed.

SYRUP PERCOLATOR.—F. DE CLERCQ, New York, N. Y. The aim of the invention is to produce a percolator in which sugar can be readily dissolved without coming into contact with the air, and from which the syrup may be readily withdrawn from the syrup compartment beneath. A further object is to provide a filtering bottom for the sugar compartment.

DRAG.—J. BLADHOLM and A. BLADHOLM, Marshall, Minn. The invention is an improvement in drags for smoothing and shaping roads, etc., and has in view such a device embodying elements of strength and durability, and primarily built of standard cross sectional forms of rolled steel, the drag being capable of being drawn either in alinement with the road or at an angle thereto and operating to shear the dirt off rather than tear it apart.

ENVELOP.—L. C. VAN RIPER, New York, N. Y. The envelop is provided with an ungummed flap which may be held within a pocket, or removed therefrom in order to allow the contents of the envelop to be inspected by the postal authorities. It is provided also with an ordinary gummed flap intended to be sealed in order to give the envelop the appearance of a sealed envelop and yet allow the same to be sent through the mail at the postage rates required for unsealed matter.

[illegible]ILLABLE BOTTLE.—A. MIDSO and G. GULBRANDSON, New York, N. Y. This bottle is adapted to indicate if the original contents have been removed and the object of the invention is to produce a closure for a bottle or jar, which cannot be placed in its former condition after the bottle has been opened. By this means the refilling of the bottle filled with a spurious substance is prevented.

PROCESS FOR TREATING CERTAIN ORES.—H. A. AUERBACH, New York, N. Y. In this instance the invention relates to the electrolytic separation of metals from their ores and admits of general use but is of special value in connection with the production of metallic lead from galena and other plumbic ores. The method has no direct relation to any particular form of apparatus.

AERIAL VESSEL.—L. J. SUTER, Jersey City, N. J. The aim in this invention is to provide a vessel or aeronef arranged to present a large sustaining surface and provided with means for conveniently causing the vessel to rise, descend and travel in the desired direction, the vessel being also capable of traveling on water or land.

CONCENTRATOR AND AMALGAMATOR.—J. T. E. NELSON, Bettles, Alaska. This apparatus is designed for the recovery of refined gold which with the foreign matter is held in suspension in a stream of water caused to drop perpendicularly into a mixer from which regulated outlet ports lead. The material to be treated contacts with quicksilver to effect the amalgamation and is forced upward again against the downward current, the purpose being to effect a thorough amalgamation with expedition.

CONCRETE DAM.—H. A. ICKE, Church Stretton, Shropshire, England. The reinforced concrete dam is of cellular construction capable of compensating for expansion and contraction due to climatic changes, and open on the upstream side of the dam to form pockets for reception of water to utilize the latter to give stability to the structure and producing direct tensile instead of transverse and compression stresses, thus insuring the desired resistance and providing at the same time suitable spillways for surplus water.

WATER WHEEL.—J. L. BEIL, Galena, Ill. The purpose in this improvement is to provide a water wheel adapted to be partially immersed in a stream in a horizontal position and wherein the rotor comprises a plurality of vertically movable vanes which by the movement of the rotor are moved out of and into the water.

METAL FRAME FOR GLASS PANES.—A. BUSSE, New York, N. Y. The intention here is to provide a frame in which no bulging or upsetting of the metal is necessary at the front of the frame to bring the flanges or heads of the bars into the same plane in order that the glass panes may bear flat against the inner faces of both the mullions and transoms.

BLOCK MOLD.—F. MAY, New York, N. Y.—The inventor provides a casting mold arranged to permit of conveniently closing or opening the mold for placing the plaster material therein, and for removing the block after it has been formed and the material has set and hardened. The mold is provided with removable partitions for forming a large number of blocks simultaneously, the interior faces of the mold members being provided with registering of adjacent ribs to provide each block or slab with a continuous groove along its sides.

COMPOUND BOAT.—J. D. WHITE, [illegible], London, England. The main object in this case is to provide a compound boat which shall combine great stability with small displacement, and in which each of the several hulls shall have sufficient freedom to roll, pitch, and adjust its heading, so as to avoid those excessive strains which have hitherto hindered the development of boats of this type.

SMOKING PIPE.—E. B. WHITNEY, Oakland, Cal. Mr. Whitney's invention is specially constructed for cooling smoke, insuring deposit of nicotine therefrom, and for facilitating cleaning, when required. A comparatively long circuitous passage is provided for the smoke, so that it is cooled more than would be practicable if it had a direct passage.

Hardware.

DEVICE FOR HOLDING WIRE SCREEN.—W. A. SMITSON, and A. GERMAN, Elwood, Ind. An object of the invention is to provide a device which may be located on a counter, or similarly accessible place, upon which rolls of screen of various widths and sizes may be mounted and from which the strips may be unwound as desired, measured, cut off and rolled up for immediate delivery.

SNOW SHOVEL.—G. C. POPE, Ebensburg, Pa. In this invention the purpose of the improvement is to provide a strong shovel of easy and cheap construction, and with an adjustable handle, so that either edge of the shovel may be used merely by changing the position of the handle which is rotatable.

FAUCET.—A. O. THOMPSON, Zacapa, Guatemala. The purpose of the invention is to provide novel details of construction for a faucet which adapt it for a secure but removable attachment thereof upon the side wall of a plate metal receptacle for a removal of the contents of the receptacle from time to time as occasion may require.

NUT LOCK.—W. W. SENN, Munson Station, Pa. This invention can be used to lock the nut positively on the bolt and the locking devices can be readily adjusted to unlocked position to permit the turning of the nut on the bolt without injury thereto when desired to turn the nut farther on the bolt, or off the bolt, if so desired.

DOOR-STOP.—W. LA BAW, Asbury Park, N. J. The invention has reference to door stops such as are adapted to be revolubly secured to the floor for holding the door in an open position, and each of which consists of a wedge-shaped body pivoted to the floor at its thinner end so that it can be swung into a plurality of positions.

SAFETY-GUARD FOR LOCKS AND LATCHES.—G. E. HOSCH, New York, N. Y. The more particular purpose here is to provide a guard having substantially the form of a plate provided with means whereby it may be fastened upon a door jamb or the like, for the purpose of preventing the bolt of the lock or latch from being forced back from the outside of the door, with the aid of a knife, screw-driver, or other instrument.

DINNER PAIL.—W. A. EDWARDS, Pine Bluff, Ark. An object in this case is to provide a device in which articles such as soup and coffee can be heated with very little trouble and in which the remainder of the victuals can be warmed without any danger of burning. Means provide for carrying liquid fuel for heating purposes.

SHUTTER-OPERATOR.—A. WEBER, Long Branch, N. J. One object of the inventor is to so construct the device that it may be more easily applied to a window sill and casing, and a further object is to so construct the device that it will operate upon the exterior rather than the interior surface of the blind or shutter. The invention relates more particularly to that type of operator illustrated in a former patent granted to Mr. Weber.

RATCHET DRILL.—G. W. FIES, Los Angeles, Cal. The object of the improvement is to provide a device simple and serviceable in construction and inexpensive to manufacture, which is constructed to obviate the danger of the supporting point and its advancing member being unscrewed too far and thus causing an injury to the device.

PERMUTATION LOCK.—G. H. HAMILTON, Portland, Ore. In view in this invention is a construction embodying a latch spindle having the customary knob and revoluble independently of the latch operating mechanism, the spindle being provided with a push bar to lock it to said mechanism, and also having a spring pawl to lock the bar in innermost and retracted positions, controlled by a permutation mechanism mounted on the spindle at the outside of and adjacent to the outer door knob.

LADDER.—J. VAGHI, Bethel, Conn. The inventor provides a ladder more especially designed for use on buildings, provides a safe escape in fire and allows firemen to quickly reach the upper stories, the ladder having its side bars formed of lazy tongs, and the rungs forming pivots on which the members of the tongs are fulcrumed, the ladder when folded taking little room, and in use is locked in extended position and spaced a sufficient distance from the face of the building to allow ascent and descent of persons.

KEY FASTENER.—P. J. RYAN, Spokane, Wash. The aim of this invention is to provide for preventing rotation of the key in the [illegible] the door, and in [illegible] parts, which may be [illegible] inserted or removed from the [illegible] would not at all [illegible] by the public.

Heating and Lighting.

HEATER.—G. W. [illegible] and J. A. Mc[illegible], Palisades, Colo. The invention relates especially to such heaters as are used out-of-doors. The object is to produce a heater of simple construction having a flue which especially facilitates a good draft and the rapid ignition of the fuel when the fire is started. It is adapted to be formed of sheet metal.

GAS-ESCAPE.—H. H. JUDSON, Oroville, Cal. The design is to provide an appliance for the escape of gases from gas, vapor and similar heaters, the appliance being applicable to windows of various sizes and easily set up and removed. The invention consists of an expansible window stopper, a pipe carried by and projecting outwardly from the stopper, with which the flue of the gas or oil heater connects, and a hood spaced from and covering the outer end of the pipe.

SWITCH FOR INCANDESCENT-LAMP SOCKETS.—W. A. McDONALD, [illegible], Pa. Of the several objects of this invention the main is to provide a switch for an incandescent socket which may be easily operated, requiring a great deal less force to manipulate it than the ordinary key, and which can be operated by one hand without straining the suspending cord.

COMBINED VENTILATOR AND SMOKE-CONSUMER.—J. WOOD, Noroton, Conn. The invention pertains to stoves and furnaces, the more particular purpose being to provide an appliance for regulating the draft, facilitating the combustion of the smoke, ventilating the room through which the smoke pipe passes, collecting unburned cinders from the smoke and enabling these cinders to be readily ejected.

MINER'S LAMP.—J. VAN LIEW and A. M. VAN LIEW, Houghton, Mich. The lamp is adapted to burn wax, oil or other suitable fuels and the invention refers more particularly to the construction of the wick tube and burner. The device is provided with a form of combustion chamber whereby a uniform supply of air will reach the flame, thus obviating the production of smoke and other noxious gases.

Household Utilities.

CONVERTIBLE COUCH AND BED.—L. B. JEFFCOTT, New York, N. Y. This article can be conveniently converted from a couch into a double bed and vice versa, and when in the form of a couch the two bed sections are spaced apart to accommodate the bed sections, and when these are extended they range one along side the other to form a double bed. For this use is made of a frame on which one bed section is pivoted, and the other is adapted to be raised into an active position or lowered into a folded position.

FOLDING BED.—L. B. JEFFCOTT, New York, N. Y. This bed is arranged to permit of conveniently and quickly folding it longitudinally into a small space and with the bedding between the head and foot of the bed, and to allow its extension for use without danger of collapsing. For this purpose, each of the side rails is formed of bars pivotally connected with each other and with the ends at the head and foot so that the bars swing longitudinally on folding or extending the bed.

SUSPENDED CLOTHES-RACK.—B. B. BOSWORTH, New York, N. Y. This invention refers to elevating racks or driers adapted to support clothes or similar articles to dry. The aim is to provide a device extremely light and simple in construction, with improved means for elevating the supporting frame and for maintaining it in a horizontal position.

Machines and Mechanical Devices.

TENSION DEVICE FOR WARP-BEAMS.—G. KELLER, New York, N. Y. An object of this inventor is to provide a tension device, strong and durable and which is adapted to replace the weights usually employed at the present time to keep the warp threads under tension, while at the same time utilizing the disk or drum provided upon the warp-beams in connection with the weights.

NEEDLE-CAM FOR STRAIGHT INDEPENDENT-NEEDLE KNITTING-MACHINES.—B. POPP, Couvet, Neuchâtel, Switzerland. The invention relates to knitting machines of the straight independent-needle type and more especially to the so-called locks. In the needle cam of the present invention pronounced disadvantages are overcome by preventing the needles when they are in the needle channels from an unintentional movement beyond the permissible limits.

VERTICAL ROUNDABOUT.—W. A. SULLIVAN, New York, N. Y. The more particular purpose in this patent is to provide a roundabout, including large boxes, suspended upon a frame and adapted to turn [illegible], its motive power being wholly or partially supplied by the [illegible] of passengers or of heavy passenger carriages.

SPEEDOMETER.—R. C. [illegible], Toledo, Ohio. A shaft is [illegible] at [illegible] of gravity of the [illegible] adapted to be [illegible] when [illegible] of [illegible] it is adapted to rotate a shaft on which a governor is mounted to revolve therewith, the governor having a spider slidably mounted on the shaft which operates levers which draw tape wound on a drum mounted in the indicator wheel shaft.

MIXING-MACHINE.—W. McRae, Eastman, Ga. This invention relates to mixing machines of the rotatable box type, and the improvements are designed more particularly for a machine for the mixing of guano or commercial fertilizer. The machine comprises a rectangular box mounted for rotation about one of its diagonals as an axis, and a series of stationary paddles mounted within the box on a shaft disposed on the diagonal.

APPARATUS FOR THE CONTROL AND THE REGISTRATION OF THE OPERATIONS PERFORMED BY DISTRIBUTING MACHINES.—Ch. L. F. Soulage, 44 Rue de Chauny, Paris, France. The present invention has reference to a device for use in controlling and registering the operations performed by distributing-machines of all kinds and more particularly to machines for distributing railway tickets. The object of the inventor is to add up the amounts of the individual sums borne by the tickets issued.

SYNCHRONIZING APPARATUS.—P Pisani, 224 Via Cavour, Rome, Italy The object of this invention is to provide an electromechanical apparatus for synchronizing automatically the movement of a kinematograph with that of one or more talking machines. The talking machine is actuated by a source of power quite distinct from that which causes the rotation of the kinematograph, and preferably by the power derived from a clock-spring previously wound.

GLASS MOULDING MACHINE.—W J Miller, Coffeyville, Kan. In operation when the mold reaches the charging position, a gatherer places a charge in the mold, and starts the table operating mechanism. The table is at once partially rotated to bring the charge into position for pressing and the pressing operation is continued a predetermined time according as the pointer is adjusted with reference to the scale. When the piston reaches the lower end of the cylinder of the timing device, it shifts the valve controlling the forming plunger cylinder, and this plunger is raised.

BAND-SAW WHEEL.—C A. Putnam, Tupper Lake, N Y Details of construction are provided whereby the width of the faces of the pair of band-saw wheels may be decreased, to compensate for decrease in width of the saw, due to successive cutting away of the saw blade in sharpening the teeth, the saw teeth being thus projected beyond the sides of the wheels, and the band of the saw adapted for close contact with the faces of the wheels, that is essential for the rotatable movement of blade without slipping while in operation.

PULP-SHAPING MACHINE.—A Komp, New York, N Y Mr Komp finds that he is enabled by his invention to overcome some former objections by using in the place of the rubber covering of the die, a thin resilient cover, preferably of sheet metal, which is detachable with the article produced This cover gives a smooth finish, requiring no further work for its completion. Means provide for locking one of the dies successively closer to the other die after each movement of the latter, whereby the pulp may be subjected to repeated and increasing pressures.

Prime Movers and Their Accessories.

VALVE FOR ENGINES.—O Pearson, Worcester, Mass. The valve stem is mounted in a valve cage having openings for admission of gas, and outside this cage is mounted the spring for normally maintaining the valve in closed position. A rock shaft is mounted on the wall of the valve cage and one arm from this shaft engages the valve stem and the other arm is operatively connected with the spring. The spring, rock shaft and other supports are entirely outside of the valve cage and out of the path of the incoming air or gas.

Railways and Their Accessories.

COMBINED SIGNAL AND AIR-BRAKE.—A. M. Jones, Hagerstown, Md. The invention pertains to means for automatically operating the brakes and for sounding an alarm An object is to provide devices by which the brakes may be automatically set and the alarm sounded, said devices being located alongside of the track upon which the train is running.

RAILROAD SWITCH.—G D. Wesley, Texarkana, Ark. In this instance the object is to provide novel details of construction for a railroad-switch, which co-operate with a fixed frog point and pivoted wing rails therefor, so as to enable the effective control of the switch and dispense with guard rails usually used in connection with a switch of the type indicated.

LOCOMOTIVE ASH-PAN.—T. W Anderson, Fort Smith, Ark. The main purpose of this invention is to provide means whereby the pan may be dumped and in which the warping of the pan [illegible] not necessarily interfere with the workings of the dumping mechanism. The pan joints are protected from heat, thus [illegible] the [illegible] of fire from glowing coals, which are dropping through open joints, doing a [illegible].

CAR-FENDER.—[illegible], New York, N. Y. This invention pertains to car-fenders such as are attached at the forward end of street or trolley cars for saving persons from being run over The cradle is normally disposed in an inoperative position under the forward end of the car, but comprising a trip frame which when touched by the body, automatically releases the cradle so that it advances so as to present its forward edge under the body The motorman can directly release the cradle.

AUTOMATIC SWITCH FOR RAILWAYS.—F R. Y Torres and F S. De La P. Y Martines, Habana, Cuba. The switch co-operates with means carried by the car, which enables the operator of the car to throw the switch to open or closed position in advance of the car In this way the car operator can advance the car on the main track or turn it into the siding or switch without leaving his platform.

Pertaining to Recreation.

ARTIFICIAL BAIT.—M A Burthe, University, Va. The object here is to provide a bait, designed to resemble a small animal such as a frog, cricket or grasshopper and so constructed that the resistance of the bait as it is drawn through the water, will cause a movement of portions of the mechanism, resembling the movements of the members of the animal which the bait represents.

AMUSEMENT DEVICE.—R. H Alexander, Paterson, N J This device is of the rotary type and adapted to give simultaneously a reversing circular travel, a counter whirling rotary motion, and a billowy rocking motion. It is adapted to give a variety of circular billowy motions, calculated to please the occupants.

OPTICAL-ILLUSION APPARATUS.—E. P Hoyt, New York, N Y A mirror is employed in this device and in connection therewith, an approximately horizontal screen, so positioned relatively to the mirror that it will serve to screen one s hand while writing or drawing on a sheet of paper or pad beneath the screen, the mirror being so positioned that the reflection of the hand and the writing or drawing will be seen.

SINKER.—G W Teasdale, New York, N Y Mr Teasdale s patent relates to sinkers admitting of general use, and particularly to the type used in connection with a line for purposes of fishing. The sinker comprises a body near the ends of which are slots for use in holding a cord, and a spring winding mounted on the body and provided with portions extending into the slots for the purpose of gripping the cord therein.

BASE-BALL-GAME APPARATUS.—J W B Dman, New York N Y In this patent the inventor has reference to certain improvements in apparatus for playing a game closely analogous to the ordinary game of base ball, but played by operating dummy players mounted on a suitable support representing the field and diamond.

SOUNDING TOY.—W Bartholomae, New York, N Y This invention relates to a device for making a noise More particularly stated, it comprehends a sounding body a clapper for striking the same, and a star wheel for actuating the clapper these parts being of approved construction so as to give the complete device a maximum of efficiency

Pertaining to Vehicles.

MOTOR CYCLE.—J E. Allen, Trenton N J The inventor's intention is to provide improvements in motor cycles, whereby the main frame is spring-supported at both wheels, to reduce the shock and jar, incident to riding over rough places, to a minimum, the construction of the frame permitting the use of long and strong elliptical springs and bringing the rider s seat as low down as possible.

AUTOMOBILE-AXLE.—M D. Tindal, Columbia, S C. More especially the improvements relate to axles used in automobiles and similar motor vehicles, which permit the turning of the wheels on vertical axes in response to the movements of the steering mechanism. The vertical turning axis may be located in the plane of the wheel itself instead of being outside of the plane as common in ordinary construction

TRUCK.—C. J Ingard, San Francisco, Cal. The object in this case is to provide a truck which may be used to store lumber on board ship and other places, the truck being so constructed that by lifting one end of the load and depressing the other end the truck with its load may be swung to the desired direction in which the load is to be moved.

WHEEL.—C C Foss and C. L. White, Quitman, Ga These patentees have produced a wheel of the type in which metallic springs are arranged between the inner and outer rims. The invention resides in the special form of the springs which comprise heart-shaped bodies, the apex of which connect with one rim the other rim receiving a standard extending to the opposite end of the spring.

Designs.

DESIGN FOR A HAMMOCK.—D W Satorius, New York, N. Y The design in this case shows the hammock body ornamented by a series of grotesque images, faces, symbols, etc., which is very unique and effective.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of March 13th or will be sent by mail on request.

(12152) E. A. L. says Kindly explain why hot water freezes more quickly in winter time than cold water The writer set out two pans of water last winter one of boiling water and the other of hydrant water, and the boiling water froze more rapidly than the other A The only physical difference we know between water which has been boiled and water which has not been boiled is that the former has lost its dissolved air by boiling For this reason it may cool and freeze more quickly

(12153) C. K. asks In what year does the first point of Aries (I mean by that the point where the ecliptic cuts the celestial equator in spring) enter the sign of Aquarius? A We have no star map which definitely locates the eastern limit of the constellation Aquarius, so that its distance from the present location of the first point of Aries can be determined. This distance in degrees, divided by 50.2 sec., the constant of precession, will give you the time required before the first of Aries will enter the constellation Aquarius. The answer to your question as you ask it is that the first point of Aries will never enter the sign Aquarius. Each sign occupies two hours or 30 deg. on the sky and they are always in the same order moving backward together around the sky carrying the pole of the heavens around the pole of the ecliptic The astronomers at the Naval Observatory Washington, D C., will have the data you require

(12154) S F says Will you please let me know if a small wireless outfit will work satisfactorily from the top of an ordinary dwelling say 60 feet from the sidewalk? About two blocks distant in one direction is a large building twelve stories high and in the neighborhood a couple of other high buildings. A. A wireless telegraph station will work very well in the city situated as you describe. Many young men are working with their friends under these conditions The station on the top of the Waldorf-Astoria is sending many messages a day far out to sea to friends on steamers.

(12155) J H T asks Will you please explain in your notes how mathematical *instrument makers fill the graduations* (on a circle for instance) with the black paint and what is the black paint used? A A very good paint for filling the graduations of a rule or a thermometer is made by rubbing lampblack into shellac till the proper consistency is obtained It should be thicker than for use with a brush It is then rubbed on and in with a cloth. After the shellac has set, the excess can be taken off with a cloth wet with turpentine

(12156) G E. H says The commercial dry cell which contains the two elements a zinc rod and a carbon stick, consists of such ingredients as powdered manganese dioxide and gas carbon and ammonia chloride Now what I am anxious to know is this What chemical reactions are involved when a dry cell is in operation? What ultimate chemical changes have taken place in each ingredient when the cell is exhausted? That is to say, what new compounds have been formed in the cell? A The chemical reactions in a dry cell are the same as in any cell in which the same materials are used The manganese dioxide is changed to manganic oxide by giving off oxygen to unite with hydrogen to form water The ammonium chloride is decomposed, and the resulting products are quite complicated The ammonia is absorbed by the water till it is saturated zinc chloride is formed. Double salts of zinc and ammonium crystallize upon the zinc. An excellent chapter on dry cells is contained in Cooper's Primary Batteries," which we can supply for $4 postpaid.

(12157) R. P D says Kindly give a process for preserving fruit for exhibition purposes. One that will not bleach shrivel or change the appearance is highly desired I have tried an aqueous solution of salicylic acid and sterilized by heat, but the color was almost removed and the skins cracked Some real estate agents want to show what can be raised in the way of fruits on irrigated lands Would not petroleum benzine do the work? A Try the following fruit or vegetables are just dropped into it (cold of course) and sealed to bear transportation Sulphurous (not sulphuric) acid, 1 part; alcohol, 1 part, water 4 parts.

(12158) L. C J says 1 Can an angle be trisected? If so, what is the rule? A. Some angles can be trisected, 90 deg for example. All angles cannot be, and there is no rule for doing it. 2. If a horse is hitched close to the load, is it easier for him to pull than if he is hitched farther from it? If so, what is the cause? A. It is a common belief that a horse can draw a load more easily when the trace is short The only reason we can see for it is that the horse tends to lift the front of the load slightly when hitched near the cart, and thus makes it easier to overcome the inequalities of the road These questions have been frequently answered in our Notes and Queries.

NEW BOOKS, ETC

The Conquest of the Air. By Alphonse Berget New York G P Putnam s Sons, 1909 8vo, 295 pp, 100 illustrations. Price, $3 50

This book is a popular work, which will serve to introduce the layman to the subject of aeronautics. It is divided into two parts the first of which deals with dirigible balloons, and the second with aeroplanes and other forms of heavier than air flying machines The book is interestingly written and while it does not go into great detail, it gives the essential facts regarding airships and aeroplanes of the past and present The first section of the book goes very thoroughly into the subject of the dirigible balloon and its history Numerous fine half tone cuts illustrate the work and there are also nearly a score of diagrams for elucidating various principles.

Aerial Navigation of To-Day By Charles C Turner Philadelphia J B Lippincott Company 1910 12mo 327 pp, 70 illustrations and diagrams. Price, $1 50

This is another popular book upon aeronautics. Besides mentioning and describing various of the leading dirigibles and aeroplanes, the author goes into the history of ballooning and of aviation The principles of mechanical flight and of aerostatics are discussed and the usefulness of flying machines and dirigibles for war and commerce is thoroughly gone over The author recognizes that a new industry has been born and discusses its effect upon society There are chapters upon aerial law, charts and landmarks, long-distance flying and lessons in flight The sensations experienced during *flight and the limitations that surround it* are also mentioned. The book contains an appendix of various useful tables giving the specific gravity of woods and of gases and the weights and properties of some of these woods the weights of various birds in proportion to their wing area thermometer conversion tables and Chanute s table of lift and drift There is also a glossary of aeronautic words and a table of French aeronautical terms and their meanings The book will be read with interest by the beginner in the new science of aviation

Master Painters of Britain By Gleeson White New York John Lane Company 1909 4to, 390 pp Price $3 postage 35 cents.

The sumptuous volume before us is filled with excellent reproductions in half tone of the best examples of the master painters of Britain The selection is a most admirable one British art has been both very bad and very good, and it is very easy to perpetuate the indifferent pieces Among the notable engravings which are scattered through the book we note the following which are particularly interesting The Death of the Earl of Chatham' by John S Copley The Death of Nelson by Benjamin West Stirling Castle by Nasmyth The Inside of a Stable by George Morland The Windmill by John Crome 'The Hay Wain by John Constable Then follow reproductions of some of the works of Watts Sir Noel Paton Dante Gabriel Rossetti and Sir John Millais One of the works of the latter entitled Chill October shows his first great landscape which was received in 1871 with an outburst of popular appreciation and amazement that a figure painter should attempt pure landscape for in those days the idea was very strong that a man should be a specialist and not try to express himself in different branches of art. To give even the names of the other interesting pictures would be simply to give an index of the illustrations of the book There is hardly a bad selection in the whole work The engravings are admirably reproduced and the text is adequate

Tables of the Properties of Steam and Other Vapors and Temperature entropy Table By Cecil H Peabody New York John Wiley & Sons 1909 8vo, 133 pp Price $1 net

These tables for the use of students of engineering and for engineers in general were published twenty one years ago and now that the properties of steam have been redetermined by new and refined methods they have been entirely recomputed and there has been added a temperature-entropy table especially adapted to steam turbine calculations The certainty and precision of the new determination of the properties of both saturated and superheated steam and the concordance of computation with the experimental data are such that the tables may be used with confidence and may be expected to have permanence

Outlines of Chemistry with Practical Work By Henry John Horstman Fenton First Part Cambridge England University Press New York G P Putnam Sons 8vo 367 pp Price $3

Anything which emanates from the University Press is sure to be of the highest possible scientific value The book before us is intended for students who have considerable knowledge of chemistry already. The author states that the subject matter indicated in the present volume has to be covered in less than two terms by candidates for the Natural Science Tripos at Cambridge. In the two succeeding terms the work is completed along the same lines. The outlines of electrochemistry, thermal chemistry and photochemistry are briefly introduced and subjects such as diffusion, colloids, alloys, allotropy and isomerism are also dealt with. The periodic classification is considered at some length and a descriptive account of the elements and their more important compounds is incorporated with this part of the subject as far as time allows. If it should happen that the present book is found of assistance to students it is the author's intention to publish this later part of the course as a second volume. From what has been said it will be seen that it is doubtful if the work will prove of a great deal of assistance as an enlarged textbook, as our methods of teaching are somewhat different from those in vogue at English universities. The book, however, is an excellent one for those who already have a considerable knowledge of chemistry.

Modern Homes. Selected Examples of Dwelling Houses Described and Illustrated by T. Raffles Davison. London: George Bell & Sons. New York: The Macmillan Company. 1909. 8vo.; 248 pp. Price, $5.25 net.

No one has seen more modern homes than Mr. Davison, and no one certainly knows better than he how to choose and present them to us. His architectural knowledge insures that the architecture is represented in such a manner as to satisfy the architect, while the artist in him insures that this shall not be emphasized at the expense of the general effect of his drawings. Here we have selected by one who knows some of the best and most representative modern homes. Views of exteriors and interiors, staircases, chimney corners, halls and furniture are given, often accompanied by plans just sufficient to place them in their surroundings, and very often a sketch or two in the garden and sometimes a photograph. Drawings are accompanied by just enough letterpress to draw attention to the strong points of each design, with entire absence of any wearisome technical detail which would be out of place in such a book. The book is beautifully illustrated and one which we can commend to all architects.

Notes on Practical Mechanical Drawing. Written for the Use of Students. By Victor T. Wilson, M.E., and Carlos L. McMaster, M.E. Lansing, Mich.: Published by Wilson & McMaster. 1909. 8vo.; 186 pp.

This book is a collection of notes intended to furnish the basis for a course in elementary mechanical drawing, so arranged, it is thought, that the teacher may have the widest latitude in his choice of sequence of subjects. Since the first edition two years ago this book has been rearranged with this particular point in view. It has been thoroughly revised and also enlarged by the addition of more explanatory matter and illustrations in a [illegible] graphic section and a chapter on dimetric and oblique drawing and a number of chapters on working drawings and sketches. It is an excellent work.

The Romance of Modern Chemistry. By James C. Phillips, D.Sc., Ph.D. Philadelphia: J. B. Lippincott & Co. 1909. 12mo.; 348 pp. Price, $1.50.

This book contains a delightful account in non-technical language of the diverse and wonderful ways in which [illegible] are at work and of their manifold applications in modern life. [illegible] partly meets [illegible] who think [illegible] of chemistry [illegible] that its familiarity [illegible] and its practical bearing [illegible] appreciated [illegible] by those who have access to a [illegible] laboratory, the [illegible] of which are [illegible] definitions. This is a mistaken view, for [illegible] the general reader [illegible] is supplying the ordinary [illegible]. In the present [illegible] dealt with [illegible] from those of ordinary textbooks. The book is fascinating and it can be read with profit by almost any one.

Tables and Diagrams of the Thermal Properties of Saturated and Superheated Steam. By Lionel S. Marks, M.M.E., and Harvey N. Davis, Ph.D. New York: Longmans, Green & Co. 1909. 8vo.; 106 pp. Price, $1 net.

The tables of the properties of saturated steam which have appeared up to the present time have all been based upon the classic investigations of Regnault carried out more than sixty years ago. More recent investigations are the necessary basis for any determination of the properties of superheated steam. These investigations, it is suggested, are a careful analysis of the data both as to the probable errors resulting from the method of experimentation and also as to the relation of the experimental results to the values deduced from the thermodynamic theory so far as the latter throws any light on the matter. Where the results of the separate investigations are not closely in accord, a critical estimate has been made of the relative values to be given to each in the region under consideration. This work will prove of great value to mechanical engineers.

The Metallurgy of the Common Metals, Gold, Silver, Iron, Copper, Lead and Zinc. By Leonard S. Austin. San Francisco: Mining and Scientific Press, 1909. 8vo.; 494 pp. Price, $4.

This is a second revised and enlarged edition which is embellished by 195 illustrations. This book discusses principles and illustrates them from current practice. It is simple and concise. It includes the data essential to an understanding of the treatment of gold, silver, copper, iron, lead and zinc ores. It affords a broad, solid foundation to the general student of metallurgy and complete information regarding related lines of work to the specialist in any one branch. Some of the illustrations are a revelation as to the latest metallurgical processes. It shows that it is an eminently practical book.

One Thousand Formulas. By L. W. Marshall. Boston: The Spatula Publishing Company. 99 pp.

This compilation gives the practical working druggist full information about the making of the most common and salable preparations, as well as about many others which so far it has been difficult to find elsewhere. As the formulas are very recent, it would admirably supplement older receipt books.

The Garden Calendar for 1910. By Ellen P. Williams. Philadelphia: Franklin Printing Company. 1909. Price, $1.

This is a wall calendar of 365 sheets, each one of which is embellished by an appropriate quotation or some practical hint for the garden. The charm of the Garden Calendar by Miss E. P. Williams is the practical advice for every day in the year, advice coming at just the time it is needed. Thus on the very day you should spray your rose bushes to prevent the rust from forming it tells you to do it. If you want advice as to your pansies, your peonies, your larkspur, your violets or your fruit trees, or even your vegetables, you will have it when you want it. You do not have to dig this advice out of a mass of other information of no immediate value. It will make an excellent holiday gift.

Rules for Recovering Coal Mines After Explosions and Fires. By W. F. Garforth, Mem. Inst. C.E., F.G.S. London and New York: D. Van Nostrand & Co. 1909. 18mo.; 71 pp. Price, $1.50 net.

The subject is a most important one and has attracted a great deal of attention in this country as well as in England.

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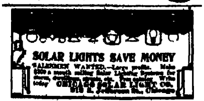
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PHOTOGRAPHING A STAR SPECTRUM.

(Continued from page 485.)

of Lake Geneva, the summer home of many of the Windy City's millionaires. On high ground to the north of the lake, the observatory presents a fine appearance with its great dome to the west and two smaller domes to the east of the buildings. Passing through the main doors, one enters a fine rotunda, and going up a flight of marble steps comes into the great dome, 90 feet in diameter and gazes on the great telescope towering aloft. One beholds a massive iron stand supporting an immense steel tube of boiler plate sixty two feet in length, five feet in diameter at the middle, tapering to three and a half feet at either end At the upper end of the tube is the object glass, with a clear aperture of forty inches, at the other end the eyepiece and micrometer, for viewing and measuring the planets and stars, or these may be replaced by a camera attachment for photography, or by a spectrograph for obtaining the spectra of stars planets, or sun The telescope tube is so long that the eye end is about thirty feet higher when an object is viewed near the horizon, than when looking at a star directly overhead. To use such a telescope, requiring as it would a long system of ladders, would be well nigh impossible, were it not for an invention of Sir Howard Grubb in making the whole observing floor an elevator The front page illustration shows the floor at its lowest point, while another view shows the floor raised as high as possible At Yerkes the floor, seventy five feet in diameter, big enough to seat six hundred people, can be raised and lowered through a distance of twenty three feet, and thus the observer when working with the telescope may keep the floor at a convenient distance below the end of the telescope, the operating power being electricity In the front page illustration are shown two of the four counterweights that balance the floor An idea of the size will be obtained by remembering that the dome is ninety feet in diameter When the astronomer wishes to observe a particular star, it is necessary to turn the slit of the dome in the direction of the star, and hence the dome must be revolved This is ninety feet in diameter and weighs one hundred and forty tons, but again by the aid of electric motors it can be rotated at will by turning on the electric current from the rising floor

Turning to the telescope we find a machine of fifty-three tons in weight, wherein the movable parts weigh twenty tons. This weight the astronomer has to put in motion when he turns the telescope, yet ball bearings and the refinements of modern engineering permit him to move the great machine, using only his own physical strength For quickly turning the telescope, electric motors are used The telescope is set up by what is known technically as the equatorial mounting, one axis, the polar axis, in the meridian parallel to the earth's axis of rotation, the other, the declination axis, at right angles to it. Circles on these two axes give the astronomer the means of locating the star by its hour angle and declination When the star is once in the field of the telescope, it is kept there by a clockwork mechanism driving the telescope about the polar axis at a speed exactly equal and opposite to the earth's rotation. The writer of this article has used the telescope when the thermometer stood at 26 deg below zero Fahrenheit, and yet at this temperature the mechanism worked to perfection, which speaks wonders for the excellence of this mounting made by the well-known firm of Warner & Swasey Indeed the professional astronomer has a hard life of it, which requires a great amount of physical endurance. In the summer nights when the temperature renders life comfortable, the nights are short, the astronomer might then be permitted to join a labor union; for he can

(Concluded on page 496.)

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(Continued from page 488.)

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[illegible] cable, spaced at equal distances of [illegible] feet apart. These buckets are held to the runners by a one-half by two-inch steel frame, allowing it to swing freely on an axle between the flanged wheels. The seating capacity of each bucket is four.

In the entire distance there are fifty towers, built of eight by eight timbers, most of which were cut within a mile of the road. Over these towers run the cables. The stationary cable is the higher one, the haulage cable being two feet below and carried midway in the frame that supports the buckets. This haulage cable is endless, winding about a huge drum at either terminal. The towers are not placed an equal distance apart, but according to the slope and the contour of the ground On the longer stretches they are frequently two hundred feet between, while at the base and summit they are within a few feet of one another Perhaps the best example of the entire simple working plan may be found in the large stores of a city, where package carriers are in use The little wire baskets that carry your purchases from the clerk to the wrapper are in miniature duplicates of these huge man-carrying buckets, save where the former are operated by springs, the latter are moved by electric power

The entire distance covered, from base to summit, is one and one-half miles, and in traveling this you are raised from nine thousand feet at Silver Plume to something greater than twelve thousand five hundred feet at the summit. This is, approximately, one foot lift for every two feet covered In order to attain the same elevation, any road in the world—Pike's Peak cog road a possible exception—would have to traverse several times the distance The time is thirty minutes each way

The motive power is electric the current being transmitted from Georgetown, four miles distant. Two motors are used, both of thirty-five horse-power each, and both located at the upper terminal One motor is sufficient to operate the endless cables on an average haul, but on other occasions, where the buckets are filled, both are thrown in

The entire road is equipped with electric signals and telephones. In its length are five stations, built about the towers, each with its watchman The slightest accident is promptly telephoned to the engineer, and the buckets stopped

The plans were first drawn up late in 1905, and the construction commenced the year following It was not until the summer of 1908, however, that the road was in full running order The total cost was slightly in excess of $70,000

A MACHINE FOR SIMULTANEOUSLY FIRING MANY BLASTS.

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by the shaft. When the switch is thrown to the lower contact, the fuse circuit receives the whole current from the electric generator

All of the fuses are melted instantly by the heavy rush of current accentuated by the inductive kick of the coil, thus producing a simultaneous firing of all the charges of explosives used In deepening the river at Sault Ste Marie for the United States government, the contracting firm used three similar machines, but larger and more powerful, operated by compressed-air engines. These machines were perfectly automatic and unfailing in operation. In all cases the fuses were arranged in parallel circuit between the two mains of the dynamos, the pressure being 12 volts. It is stated that these devices operated so simply that it required only the opening of an air valve to fire three hundred charges of dynamite at one time.

* * *

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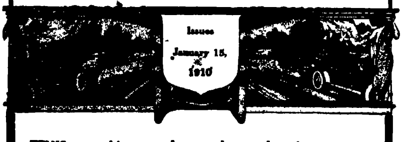

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2 *How to Overhaul Your Car*

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4. *The Automobile and the Road*
The automobile has presented to the road engineer new problems for solution. He must render his roads impervious to water and practically proof against the destructive effect of tires The United States Government through the Office of Public Road Inquiry is now studying this subject. The article written by Mr Page, Director of the Office of Public Roads, describes what has been done

5. *Anti "Joy Ride" Devices.*
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6 *The Modern Electric Automobile*

7 *Making Your Own Repairs.*

8 *The Cars of 1910*

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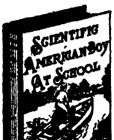

THIS book is a sequel to The Scientific American Boy many thousand copies of which have been sold and has proven very popular with the boys The main object of the book is to instruct how to build various devices and apparatus particularly for outdoor use The construction of the apparatus which is fully within the scope of the average boy is fully described and the instructions are interwoven in an interesting story a feature which has assisted in making the Scientific American Boy so popular with the boys

It takes up the story of Bill and several of his companions at boarding school They form a mysterious Egyptian society whose object is to emulate the resourcefulness of the ancients Their Chief Astrologer and Priest of the Sacred Scarabæus is gifted with unusual powers but his magic is explained so that others can copy it. Under the directions of the Chief Engineer dams, bridges, and canal locks are constructed The Chief Admiral and Naval Constructor builds many types of boats, some of which are entirely new The Chief Craftsman and the Chief Artist also have their parts in the work done by the Society over which Pharaoh and his Grand Vizier have charge Following is a list of the chapters

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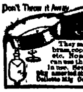

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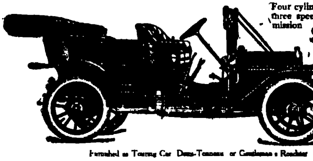

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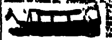

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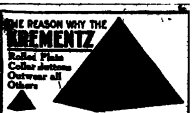
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